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TECHNICAL MANUAL

AIRCRAFT WEAPONS SYSTEMS CLEANING AND CORROSION CONTROL

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SAFETY SUMMARY

The following general safety precautions are not related to any specific procedures, and, therefore, do not appear anywhere else in this publication. These are precautions that personnel must understand and apply during all phases of operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must observe safety precautions at all times. Do not replace components or make adjustments inside any equipment with the high voltage supply turned on. Under certain conditions, dangerous potentials may exist when the power is in the off position due to charges retained by capacitors. To avoid casualties, always remove power from, discharge, and ground a circuit before touching it.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances shall any person reach into or enter an enclosure for the purpose of servicing or adjusting the equipment, except in the presence of someone who is capable of rendering aid.

RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of resuscitation. Such information may be obtained from the appropriate medical commands.

ENGINE NOISE

Personnel must observe the following precautions when working within danger areas of jet engines:

a. Wear the proper protection (earplugs and/or earmuffs).

b. Do not exceed the time limits of exposure to various sound intensities.

c. Have periodic hearing ability checks.

FLIGHT LINE SAFETY PRECAUTIONS

Personnel working in or around aircraft on the flight line shall observe flight line safety precautions and regulations.

USE SAFETY SHIELDS

Observe applicable safety regulations and use safety shields on power tools where provided. Adequate shielding to protect eyes and face shall be used at all times when operating power tools or performing pressure tests.

SEAT EJECTION MECHANISMS

Safety precautions shall be strictly observed when working around aircraft equipped with an ejection seat. These safety precautions cannot be overemphasized. Each ejection seat has several around safety pins. These safety pins are provided on red–flanged lanyards for use at every point of potential danger. They shall be installed whenever the aircraft is on the ground or deck, and must never be removed until the aircraft is ready for flight.

The following general precautions should always be kept in mind.

a. Ejection seats shall be treated with the same respect as a loaded gun.

b. Always consider an ejection seat system as loaded and armed.

c. Before entering a cockpit, know where the ejection seat safety pins are and be certain of their installation.

d. Only authorized personnel may work on or remove and install ejection seats and components, and only in an authorized area.

WARNINGS AND CAUTIONS USED IN THIS MANUAL

Warnings and cautions are inserted throughout the text of this manual to notify personnel of potential hazards. Warnings are used to alert personnel to potential safety and health hazards. Cautions are used to alert personnel to conditions which could result in damage to equipment or property.

CHEMICAL SAFETY

Aircraft maintenance chemicals (such as abrasive materials, cleaners, corrosion preventives, paint strippers. surface treatments, sealants, paints, solvents, etc.) may be hazardous to skin, eyes, and respiratory and digestive tracts when misused, when used without proper precautions or safety devices, or when used without personal protective equipment (PPE).

SLearn the warnings and cautions for using specific maintenance chemicals and procedures. Observe manufacturer’s warning labels and the warnings and cautions in this manual and other applicable maintenance instruction manuals (MIMs).

SObtain and use personal protective equipment (such as goggles, respirators, gloves, boots, aprons, etc.) as recommended by the local safety office, industrial hygienist, bioenvironmental engineer, material safety data sheet (MSDS), DOD 6050–LR or this manual.

S Insure that sufficient ventilation exists. Cartridge respirators only filter out the airborne contamination for which they were designed. Respirators will not protect personnel if oxygen is depleted or displaced.

S When flammable materials are used, insure that all sources of ignition have been removed from the area and that only explosion proof or pneumatically powered equipment is used. Insure that fire fighting equipment is readily available and in working order.

S Do not mix maintenance chemicals with each other, unless written instructions specifically direct a mixing procedure. Many combinations of chemicals are incompatible and may produce toxic fumes and/or violent reactions. Liquid oxygen is not compatible with most organic materials; explosions have occurred on contact with greases and oils.

CHEMICAL SAFETY–Continued

- Use only the materials recommended by this manual and other applicable maintenance instruction manuals. Use only the maintenance chemicals and procedures recommended for specific aircraft components. Some chemicals are incompatible with certain aircraft materials. For example, acidic surface treatments can cause embrittlement of high strength steel and chemical paint removers can dissolve canopy materials.

MECHANICAL SAFETY

Without the proper safety devices and tools, aircraft maintenance procedures may present severe mechanical hazards (such as loss of control of tools, falling, cuts from sharp surfaces, impact of debris from high speed tools, etc.)

- Learn the warnings and cautions required for specific maintenance procedures. Observe manufacturer’s warning labels and the warnings and cautions in this manual and other applicable maintenance instruction manuals.

- Obtain and use personal protective equipment (such as goggles, respirators, gloves, boots, aprons, etc.) as recommended by the local safety office, industrial hygienist, bioenvironmental engineer, material safety data sheet (MSDS), DOD 6050–LR or this manual.

- Obtain and use the necessary safety devices (such as safety harnesses, safety lines, etc.) and tools fitted with safety devices (such as chip guards, belt guards, etc.)

- Use only those procedures recommended by this manual and other applicable maintenance instruction manuals. Unauthorized procedures can result in personal injury, damage to equipment and property, and loss of aircraft flight worthiness.

- Unless specifically allowed by shop safety procedures, remove rings, watches, and other metallic objects which may get caught in moving parts.

- Use compressed air carefully. Objects propelled with compressed air can produce severe personal injury.

ELECTRICAL SAFETY

Without the proper safety devices and tools, aircraft maintenance procedures may present severe electrical hazards (such as burns or electrocution).

- Open all circuit breakers associated with battery power (refer to applicable maintenance manuals) prior to using flammable materials on aircraft. Before cleaning electrical and avionic equipment insure that electrical power is disconnected. Electrically ground aircraft during all cleaning and painting operations.

- Do not inspect or perform maintenance on aircraft when an electrical storm is in the immediate area.

- If electrical/electronic equipment has been contaminated with conductive liquids (water, salt water, cleaners, etc.) or conductive dusts or fibers (metallic particles, graphite fibers, etc.), decontaminate the equipment prior to powering up.

- Use only those procedures recommended by this manual and other applicable maintenance instruction manuals. Unauthorized procedures can result in personal injury, damage to equipment and property, and loss of aircraft flight worthiness.

HAZARDOUS MATERIALS

Regulations which identify and limit the use of hazardous materials cover workplace practices, emissions of volatiles to the atmosphere, discharge to waste treatment systems and disposal requirements. Activities must comply with local as well as state and federal laws covering often hundreds of chemical ingredients and thousands of chemical products. As a result, base safety/environmental personnel are usually the best source of information concerning local environmental restrictions.

Prior to implementing any new process involving hazardous materials, you must consult your base safety/environmental office.

CHAPTER 1

INTRODUCTION

1–1. PURPOSE. The purpose of this manual is to provide information on materials and procedures for the prevention and repair of corrosion damage to equipment on land or at sea. Supervisory and maintenance personnel shall use this manual as a guide for all corrosion control and maintenance efforts. Contractors who are required to maintain and repair corrosion of aircraft and related equipment shall also use this manual.

1–1.1. Usage. Use this manual in conjunction with and in support of the appropriate Army Technical Manuals (TM's), Technical Bulletins (TB's), Department of the Army Pamphlets (DA PAM's), Navy Maintenance Instruction Manuals (MIM's), Navy Structural Repair Manuals (SRM's), Maintenance Requirement Cards (MRC's), and Air Force Technical Orders (T.O.'s). In the case of a conflict between this manual and other Navy manuals, this manual shall take precedence; however, maintenance activities shall contact the appropriate Cognizant Field Activity (CFA)/Fleet Support Team (FST) for immediate resolution of the conflict. The Army and Air Force specific aircraft manuals shall take precedence over this manual. Tables 1–1 (Army), 1–2 (Navy) and 1–3 (Air Force) list technical publications used as supplemental references by personnel involved in cleaning and corrosion control.

1–2. RESPONSIBILITY FOR CHANGES TO THIS MANUAL. This manual is a tri–service document, coordinated by the Lead Maintenance Technology Center for Corrosion, Naval Aviation Depot North Island, Code 4.3.4, San Diego, CA. The following activities are responsible for maintaining this document: the Naval Air Systems Command, the Air Force Corrosion Program Office, and the U.S. Army Aviation Systems Command. As necessary, representatives from these activities shall meet to review proposed engineering and logistical changes to this manual. Changes are approved by all services, except for Appendices C, D and E, which are service–specific.

1–2.1. Recommended changes, corrections, or deletions. All activities using this manual are invited to submit recommended modifications, additions, or deletions. Use the current reporting system of the parent service organization to submit these changes to the appropriate technical services facility.

1–3. SCOPE. The material in this manual contains basic corrosion prevention and corrective maintenance information to be used at Organizational, Intermediate, and Depot levels. This manual is divided into a safety summary, nine chapters, five appendices, a glossary, and an alphabetical index.

1–3.1. Safety Summary. This section provides general safety precautions that personnel shall use during all phases of operation and maintenance.

1–3.2. Chapter 1, Introduction. This chapter explains the purpose, appropriate usage and the responsibility for changes to this Manual. Also, this section presents the scope and outlay of the Manual.

1–3.3. Chapter 2, Corrosion Theory. This chapter explains what corrosion is, why it occurs, the various forms it can take, and how to recognize it.

1–3.4. Chapter 3, Preventive Maintenance. This chapter outlines accepted procedures, methods, and materials to be used in the maintenance cleaning (Section I), lubrication (Section II) and preservation (Section III) of aircraft.

1–3.5. Chapter 4, Inspection and Corrosion Prone Areas. This chapter describes inspection techniques for detecting corrosion (Section I) and discusses corrosion prone areas (Section II).

1–3.6. Chapter 5, Corrosion Removal and Surface Treatment. This chapter outlines the approved methods for the removal of corrosion damage (Section I) and the application of surface treatments (Section II).

1–3.7. Chapter 6, Sealants. This chapter covers recommended materials and procedures for the application of sealing compounds to aircraft structures.

1–3.8. Chapter 7, Paint Finish and Touch–up Procedures (Navy only). This chapter describes the approved paint systems that are used on Navy aircraft, and gives detailed procedures for the touch up system to be used by Organizational and Intermediate levels of maintenance. Army personnel should refer to TM 55–1500–345–23 and Air Force personnel should refer to T.O. 1–1–8 and T.O. 1–1–4.

1–3.9. Chapter 8, Treatment of Specific Areas. This chapter describes the recommended procedures for treating and protecting against corrosion in specific areas.

1–3.10. Chapter 9, Emergency Procedures. This chapter outlines emergency procedures to be followed after exposure of aircraft to salt water, fire extinguishing chemicals, etc.

1–3.11. Appendix A, Consumable Materials. This appendix lists the recommended materials for cleaning, corrosion prevention, surface treatment, preservation and refinishing of aircraft.

1–3.12. Appendix B, Accessories for Corrosion Control. This appendix provides accessories used for cleaning, corrosion removal, conversion coating, painting, safety and sealing of aircraft.

1–3.13. Appendix C, Supplementary Requirements for Navy Aircraft. This appendix provides information on materials and procedures specific to Navy aviation equipment.

1–3.14. Appendix D, Supplementary Requirements for Army Aircraft. This appendix provides information on materials and procedures specific to Army aviation equipment.

1–3.15. Appendix E, Supplementary Requirements for Air Force Aircraft. This appendix provides information on materials and procedures specific to Air Force aviation equipment.

1–3.16. Glossary. The glossary defines terms commonly used by personnel performing aircraft cleaning and corrosion control.

1–3.17. Alphabetical Index. This index locates specific subjects in the Manual.

1–4. CORROSION CONTROL PROGRAM. All activities responsible for aircraft maintenance shall establish corrosion control programs as required by the parent service organization. The type of program depends upon the environment to which the aircraft may be exposed. At sea, where conditions are normally the most severe, aircraft are exposed to salt spray, ship stack gases, and aircraft engine exhausts. In other environments, land–based aircraft may be exposed to industrial gases, salts, rain, mud, and, near salt water, mists containing sea salts. A comprehensive corrosion control program shall provide either a Corrosion Control Work Center or a Corrosion Control Team with trained personnel for the prevention, early detection, reporting, and repair of corrosion damage. Such a program requires a dedicated effort by all maintenance personnel to prevent corrosion before it starts. These efforts will improve the operational readiness of equipment and minimize costly repairs.

1–4.1. Training. Personnel performing maintenance on aircraft shall be trained in basic corrosion control skills as established by the parent service organization, and must be fully aware of the reasons for the corrosion control program. Without such training and understanding, further damage or additional problems will result.

1–4.2. Maintenance. An effective corrosion prevention program shall include thorough cleaning, inspection, preservation, and lubrication, at specified intervals, in accordance with Chapters 3 and 4 and Appendices C, D, and E. Check for corrosion damage and integrity of protective finishes during all scheduled and unscheduled maintenance. Early detection and repair of corrosion will limit further damage. When corrosion is discovered, treat corrosion as prescribed in Chapters 5 and 8 and Appendices D (Army) and E (Air Force) as soon as possible and use only approved materials, equipment, and techniques. Only affected areas shall be repaired. Seal in accordance with Chapter 6, and paint as required in Chapter 7 (Navy), T.O. 1–1–8 (Air Force) or TM 55–1500–345–23 (Army). All maintenance personnel shall report corrosion promptly, in accordance with directives established by the parent service organization.

1–5. SAFETY. Safety is everyone's business and concern.

1–5.1. Responsibility of Supervisors. Work center supervisors shall receive the following training in accordance with parent service directives:

a. The recognition and elimination of hazards;

b. Occupational safety and health;

c. The safety of the individual;

d. Accident investigation and reporting; and

e. The inspection and maintenance of personal protective equipment (PPE).

1–5.1.1. Supervisors shall ensure that all corrosion control personnel are informed of:

a. Current safety procedures;

b. Characteristics of materials to which they will be exposed; and

c. Required protective clothing to ensure safety of personnel.

1–5.1.2. In addition, supervisors shall ensure that an adequate supply of safety equipment is in a ready–for–issue condition, and that the personnel under their control are given, and use, appropriate protective equipment to prevent accidents, injuries, and occupational illness. Maintenance personnel shall use appropriate equipment while exposed to hazardous conditions, and shall report to the supervisor any protective equipment that is broken, damaged, defective, or inadequate. No one shall use protective equipment that is not in a satisfactory and serviceable condition. Personnel shall comply with occupational safety and health requirements, including medical examinations, respirator training and fit testing, and protection for eyes, ears, head, skin, and feet.

1–5.2. Materials handling. Many of the materials and procedures outlined in this manual are potentially hazardous to personnel and potentially damaging to aircraft, especially with improper use. When using any chemicals, such as paint removers, detergents, conversion coatings, and solvents, follow the correct procedures with appropriate protective gear to prevent personnel injury and aircraft damage. Read the appropriate warnings and cautions in this manual prior to use of any hazardous materials. Misuse of certain materials can damage parts or cause corrosion which may lead to catastrophic failure. Refer to DoD 6050.5–LR, Hazardous Materials Information System, or the appropriate parent service organization documents for the handling, storage, and disposal of hazardous materials. Refer to local directives and policies pertaining to hazardous waste management. When in doubt, contact the local safety office, industrial hygienist, bioenvironmental engineer or regional medical center.

1–6. MATERIALS. Consumable materials listed in Appendix A and accessories listed in Appendix B shall be used for corrosion control. These materials and equipment have been approved only after extensive testing to prove their ability to perform properly and effectively without damage to any of the metallic or nonmetallic materials used in aircraft. Only those materials listed in this manual shall be used for cleaning or corrosion control of aircraft components. Materials listed in other manuals shall be used only when required procedures are not covered by this manual. Materials or processes considered to be an improvement over existing ones, after local laboratory analysis and evaluation, shall be forwarded to the Aircraft Controlling Custodians (ACC) or System Program Manager (SPM) for submission to the parent service organization for further evaluation. When approved materials are not available, substitutions shall only be made by the appropriate ACC/SPM. When several methods or materials are listed, the preferred one is listed first, with alternates following.

Table 1–1. Related Army Publications

Number	Title
AR 755–15	Radioactive Waste
FM 3–5	Chemical, Biological, and Radiological Decontamination
MIL–HDBK–729	Corrosion and Corrosion Prevention – Metals
PAM 738–750	The Army Maintenance Management Systems – Aviation (TAMMS)
TM 55–1500–204–25/1	General Aircraft Maintenance Manual
TM 55–1500–343–23	Avionic Cleaning and Corrosion Prevention/Control Manual
TM 55–1500–345–23	Painting and Marking of Army Aircraft
TM 743–200–1	Storage and Material Handling

Table 1–2. Related Navy Publications

Number	Title
DoD 6050.5–LR	Hazardous Material Control and Management (HMC&M)
FED–STD–595	Color Fandeck
MIL–STD–2161	Paint Schemes and Exterior Markings for U.S. Navy and Marine Corps Aircraft
AO–410JC–OPM–000	Breathing Pump, Pneumatic, Operation and Maintenance Instructions with IPB
NA 00–80R–14	NATOPS U.S. Navy Aircraft Firefighting and Rescue Manual
NA 01–1A–1	Structural Repair, General Manual and Engineering Handbook for Aircraft Repair
NA 01–1A–12	Fabrication, Maintenance and Repair of Transparent Plastics
NA 01–1A–16	Non–Destructive Inspection Methods Technical Manual
NA 01–1A–17	Aviation Hydraulics Manual, Organizational/Intermediate/Depot Levels
NA 01–1A–21	General Composite Repair Manual
NA 01–1A–22	Radomes and Antenna Covers, Aircraft, Organizational, Intermediate and Depot Maintenance
NA 01–1A–35	Aircraft Fuel Cells and Internal/External Tanks, Organizational, Intermediate, and Depot Maintenance Instructions
NA 01–1A–507	Cements, Sealants, and Coatings, General Use of, Technical Manual

Table 1-2. Related Navy Publications (Cont.)

Number	Title
NA 01-1A-520	Anti-icing, Deicing, and Defrosting of Parked Aircraft
NA 13-1-6.4	Aviation Crew System - Oxygen Equipment
NA 15-01-4	Desert Storage Preservation and Process Manual for Aircraft
NA 15-01-500	Preservation of Naval Aircraft
NA 15-02-1	Engines, Aircraft and Aircraft Auxiliary Power Unit Engines, Desert Storage Preservation and Processing
NA 16-1-540	Avionic Cleaning and Corrosion Prevention and Control Manual
NA 17-1-125	Ground Support Equipment Cleaning and Corrosion Control, Maintenance Instructions, Organizational and Intermediate Levels
NA 17-5BM-1	Dry Honing Machine (Vacu-Blast), Portable, Operation, Service and Overhaul Instructions
NA 17-5BM-2	Dry Honing Machine (Model 12542), Stationary, Handbook Operation and Service Instruction with Illustrated Parts Breakdown
NA 17-5BM-3	Dry Honing Machine (Zero), Operation, Service and Overhaul Instructions
NA 17-600-22-6-1	Dry Honing Machine (Zero/Vacu-Blast), Portable, Pre-operational Checklist
NA 17-600-22-6-2	Dry Honing Machine (Zero/Vacu-Blast), Portable, Periodic Maintenance Requirements
NA 17-600-191-6-2	Periodic Maintenance Requirements Manual, Plastic Media Glove Box Blaster (PRC-4848)
NA 19-20D-1	Jet Engine Corrosion Control Cart, Operation and Service Instructions
NA 19-20D-2	Spray Unit, Corrosion Control, Trailer Mounted, Operation and Intermediate Maintenance
NA 19-25E-508	Aircraft Deicer, Truck Mounted, Organizational, Intermediate, and Depot Level Maintenance Instructions
NA A1-NBCDR-OPM-000	Operational Instructions, Naval Aviation Nuclear, Biological and Chemical (NBC) Defense Resource Manual
NA AG-340SO-MRC-010	Aircraft Cleaning Machine, A/M32M-28, PreOp Checklist
NA AG-34050-MRC-020	Aircraft Cleaning Machine, A/M32M-28, Periodic Maintenance Requirements

Table 1–2. Related Navy Publications (Cont.)

Number	Title
NAVSEA 49593–A7–PLN–0101	Shipboard Hazardous Material/Hazardous Waste Management Plan
*NAVFAC P–80	Navy & Marine Corps Shore Installations, Facility Planning Factor Criteria
*NAVFAC P–272	Naval Shore Facilities, Definitive Designs for
NSUP 4105	LIRSH – List of Items Requiring Special Handling
NSUP 4500	Consolidated Hazardous Items List
OPNAVINST 4110.2	Navy Hazardous Material Control and Management
OPNAVINST 4790.2	Naval Aviation Maintenance Program (NAMP)
OPNAVINST 5090.1B	Environmental and Natural Resources Program Manual
OPNAVINST 5100.23	Navy Occupational Safety and Health (NAVOSH) Program Manual

*These publications are provided for general shore facilities planning and are not limited to corrosion control facilities.

Table 1–3. Related Air Force Publications

Number	Title
AFM 91–11	Solid Waste Management
AFOSH–STD 91–66	General Industrial Operations
AFR 19–1	Pollution Abatement and Environmental Quality
AFR 91–9	Water Pollution Control Facilities
T.O. 00–5–1	AF Technical Order System
T.O. 00–20–1	Aerospace Equipment Maintenance, General Policies and Procedures
T.O. 00–20–2	The Maintenance Data Collection System
AFMAN 31–110	Inspection and Control of USAF Shelf–life Equipment
T.O. 00–25–107	Maintenance Assistance
T.O. 00–25–172	Ground Servicing of Aircraft and Static Grounding/Bonding
T.O. 00–25–234	General Shop Practice Requirements for the Repair, Maintenance, and Test of Electronic Equipment

Table 1–3. Related Air Force Publications (Cont.)

Number	Title
T.O. 00–25–235	Safety Procedures and Equipment For Confined Space Entry (Including Missile Propellant Tanks)
T.O. 00–35D–54	USAF Material Deficiency Reporting and Investigating Services
T.O. 00–110A–1	Guidelines for Identification and Handling of Aircraft and Material Contaminated with Radioactive Debris (Fallout)
T.O. 00–110N–2	Radioactive Waste Disposal
T.O. 00–110N–3	Requisition Handling Storage and Identification of Radioactive Materials
T.O. 1–1–3	Preparation, Inspection, and Repair of Aircraft Fuel, Oil, and Water–Alcohol Cells and Integral Tanks
T.O. 1–1–4	Exterior Finishes, Insignia, and Markings Applicable to Aircraft and Missiles
T.O. 1–1–8	Application or Organic Coatings (Paint and Allied Materials)
T.O. 1–1–17	Storage of Aircraft and Missiles Systems
T.O. 1–1–24	Maintenance Repair and Electrical Requirements for Fiberglass Airborne Radomes
T.O. 1–1–689	Avionics Cleaning and Corrosion Prevention/Control
T.O. 1–1–690	General Advanced Composite Repair Processes
T.O. 1–1A–1	Engineering H/B Series for Aircraft Repair – General Manual for Structural Repair
T.O. 1–1A–8	Engineering Manual Series for Aircraft and Missiles Repair Structural Hardware
T.O. 1–1A–9	Engineering Series for Aircraft Repair Aerospace Metal General Data and Usage Factors
T.O. 1–1A–12	Fabrication, Maintenance and Repair of Transparent Plastic
T.O. 1–1A–14	Installation Practices for Aircraft Electric and Electronic Wiring
T.O. 1–1A–15	General Maintenance Instructions for Support Equipment
T.O. 2–1–11	Corrosion Control of Engine Parts During Overhaul and Field Level Maintenance, Reciprocating, Turbojet, and Gas Turbine Aircraft Engines
T.O. 2–1–111 (NAVAIR 02–1–5–517/ DMWR 55–2800–106)	Standard Maintenance Practices, Navy, USAF and Army, P&W Aircraft Engines
T.O. 2J–1–13	Cleaning of Gas Turbine Aircraft Engines and Parts

Table 1–3. Related Air Force Publications (Cont.)

Number	Title
T.O. 2J–1–18	Preparation for Shipment and Storage of Gas Turbine Engines
T.O. 2J–1–32 (NAVAIR 02–1–20)	Standard Maintenance Practice Instructions – GE Aircraft Engines, Model TF–34–GE–100, A, –400, A, B, TF58–GE–3, –5, –8B, –10, –16, –100 (USCG), –400B, –402, T64–GE–6B, –7, A, 100, –413, –415, –416, –416A, F404–GE–400, YF404–GE–400, F110–GE–400, YT700–GE–401, T700–GE–401, 4
T.O. 2R–1–11	Corrosion Control – Reciprocating Aircraft Engines
T.O. 2R–1–84	Cleaning of Reciprocating Engines and Parts
T.O. 4W–1–61	Operation, Service, and Maintenance Instructions – All Aircraft Wheels
T.O. 10–1–179	Corrosion Control Manual for Photographic Equipment
T.O. 13A1–1–1	Repair, Cleaning Inspection and Testing Aircraft Safety Belts, Shoulder Harness, and Miscellaneous Personnel Restraint Equipment
T.O. 21M–LGM30F–101	Organizational Maintenance Instructions– Corrosion Control and Treatment (VAFB, Wings I thru VI)
T.O. 31–1–221	Field Instructions for Painting and Preserving Electronics Command Equipment
T.O. 33B–1–1	Nondestructive Inspection Methods
T.O. 34–1–3	Inspection and Maintenance of Machinery and Shop Equipment
T.O. 35–1–3	Corrosion Prevention, Painting, and Marking of USAF Support Equipment (SE)
T.O. 35–1–4	Processing and Inspection of Support Equipment for Storage and Shipment
T.O. 35–1–12	Compounds and Procedures for Cleaning Support Equipment
T.O. 36–1–191	Technical and Managerial Reference for Motor Vehicle Maintenance
T.O. 42A1–1–1	Evaluation and Service Testing of Materials – Cleaning, Painting, Sealing, Protective Treating, Anti–Corrosion, Inspection Materials, and Related Items
T.O. 42A3–1–2	General Use of Cements, Sealants, and Coatings
T.O. 42B–1–6	Corrosion Preventive Lubricants and Anti–Seize Compounds
T.O. 42C2–1–7	Process Instructions, Electrodeposition of Metals and Metal Surface Treatments to meet Air Force Maintenance Requirements.
T.O. 42C–1–2	Anti–Icing, Deicing, and Defrosting of Parked Aircraft
T.O. 42C–1–12	Quality Control of Chemicals

CHAPTER 2

CORROSION THEORY

2–1. PURPOSE. This chapter is an introduction to corrosion theory: the causes of corrosion and the factors which influence its development. The various forms of corrosion and the effect of corrosive environments on aircraft metals are described. The purpose of this discussion is to provide maintenance personnel with the background knowledge necessary to understand the causes of corrosion and to minimize corrosion damage.

2–2. DEFINITION OF CORROSION. Corrosion is the electrochemical deterioration of a metal because of its chemical reaction with the surrounding environment. This reaction occurs due to the tendency of metals to return to their naturally occurring states, usually oxide or sulfide ores. For example, iron in the presence of moisture and air will return to its natural state, iron oxide or rust. Aluminum and magnesium form corrosion products that are white oxides or hydroxides. When a water solution containing soluble salts is present, corrosion of many alloys can occur easily at ambient temperatures. This type of corrosion can be effectively treated by maintenance personnel as discussed in this manual. Corrosion can also occur in the absence of water but only at high temperatures, such as those found in gas turbine engines. However, the most common type of corrosion (and the one that can be most effectively treated by maintenance personnel) is electrochemical corrosion.

2–3. CHEMICAL DEFINITIONS.

2–3.1. Atom. The smallest unit of an element. There are over 100 elements, including metals such as aluminum, magnesium, gold, platinum, iron, nickel, titanium, cadmium, chromium, copper, silver, lead, uranium, beryllium, zinc, and carbon, and non–metals such as hydrogen, oxygen, nitrogen, sulfur, chlorine, helium, and boron.

2–3.2. Electron. A negatively charged particle much smaller than an atom. An electric current occurs when electrons are forced to move through metal conductors. Electrons flow through water solutions only in the presence of ions.

2–3.3. Ions. Atoms or groups of atoms bound together which are either positively or negatively charged. An electric current occurs when ions are forced to move through water solutions. Ions cannot move through metal conductors.

2–3.4 Electrolyte. A liquid (usually water) solution containing ions. Salt water is an electrolyte: an aqueous (meaning, water) solution of sodium ions and chloride ions. Electrochemistry is the branch of science concerned with chemical reactions at surfaces in contact with electrolytes.

2–4. THEORY OF CORROSION. All structural metals will corrode to some extent in a natural environment. When a metal corrodes, the metal atoms lose electrons and become positively charged metal ions in the electrolyte. In solution, the positively charged metal ions can combine with negatively charged ions to form corrosion products, such as metallic chlorides, oxides, hydroxides, sulfides, etc. Four conditions must exist before this type of corrosion can occur.

a. A metal which has a tendency to corrode must be present (the corroding metal is known as the anode);

b. A dissimilar conductive material (the cathode) which has less tendency to corrode than the anode must be present (such as a different metal, a protected part of the same metal, or conductive plastics);

c. A conductive liquid (electrolyte) must connect the anode and cathode (so that ions can carry electric current between them); and

d. Electrical contact between the anode and cathode (usually in the form of metal–to–metal contact) must exist (so that electrons can move from the anode, where they are released, to the cathode).

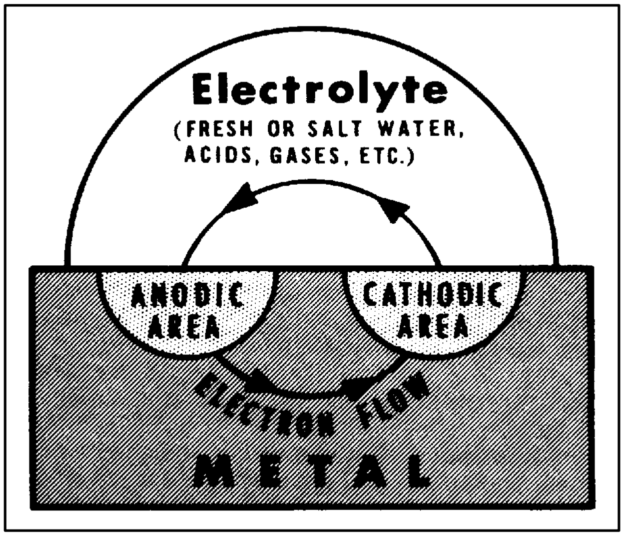


Figure. 2-1. Simplified Corrosion Cell

2-4.1. The elimination of any one of the four conditions, illustrated in Figure 2-1, will stop corrosion. For example, a paint film on a metal surface will prevent the conducting liquid (electrolyte) from connecting the anode and cathode, thereby, stopping the electric current (see Figure 2-2). Another example: two connected dissimilar metal parts placed in distilled water corrode very slowly due to a lack of ions in solution to conduct the electric current; in sea water the corrosion reaction is accelerated by a factor of 1000 or more (see Figure 2-3).

2-5. DEVELOPMENT OF CORROSION. All corrosive attack begins on the surface of metals. If allowed to progress, corrosion can penetrate into the metal. If corrosion begins on an inside surface of a component (for example, the inner wall of a metal tube), it may go undetected until perforation occurs. When corrosion products form, they often precipitate onto the corroding surface as a powdery deposit. This film of corrosion products may reduce the rate of corrosion, if the film acts like a barrier to electrolytes. Some metals (such as stainless steel and titanium), under the right conditions, produce corrosion products that are so tightly bound to the corroding metal that they form an invisible oxide film (called a passive film), which prevents further corrosion. However, when the film of corrosion products is loose and porous (such as those of aluminum and magnesium), an electrolyte can easily penetrate and continue the corrosion process, producing more extensive damage than surface appearance would show.

2-5.1. Corrosion under painted surfaces. Paint coatings can mask the initial stages of corrosion. Since corrosion products occupy more volume than the original metal, paint surfaces should be inspected often for irregularities such as blisters, flakes, chips, and lumps.

2-6. FACTORS INFLUENCING CORROSION. Some factors which influence metal corrosion and the rate of corrosion are:

a. Type of metal;

b. Presence of a dissimilar, less corrodible metal (galvanic corrosion);

c. Anode and cathode surface areas (in galvanic corrosion);

d. Temperature;

e. Heat treatment and grain direction;

f. Presence of electrolytes (hard water, salt water, battery fluids, etc.);

g. Availability of oxygen;

h. Presence of different concentrations of the same electrolyte;

i. Presence of biological organisms;

j. Mechanical stress on the corroding metal; and

k. Time of exposure to a corrosive environment.

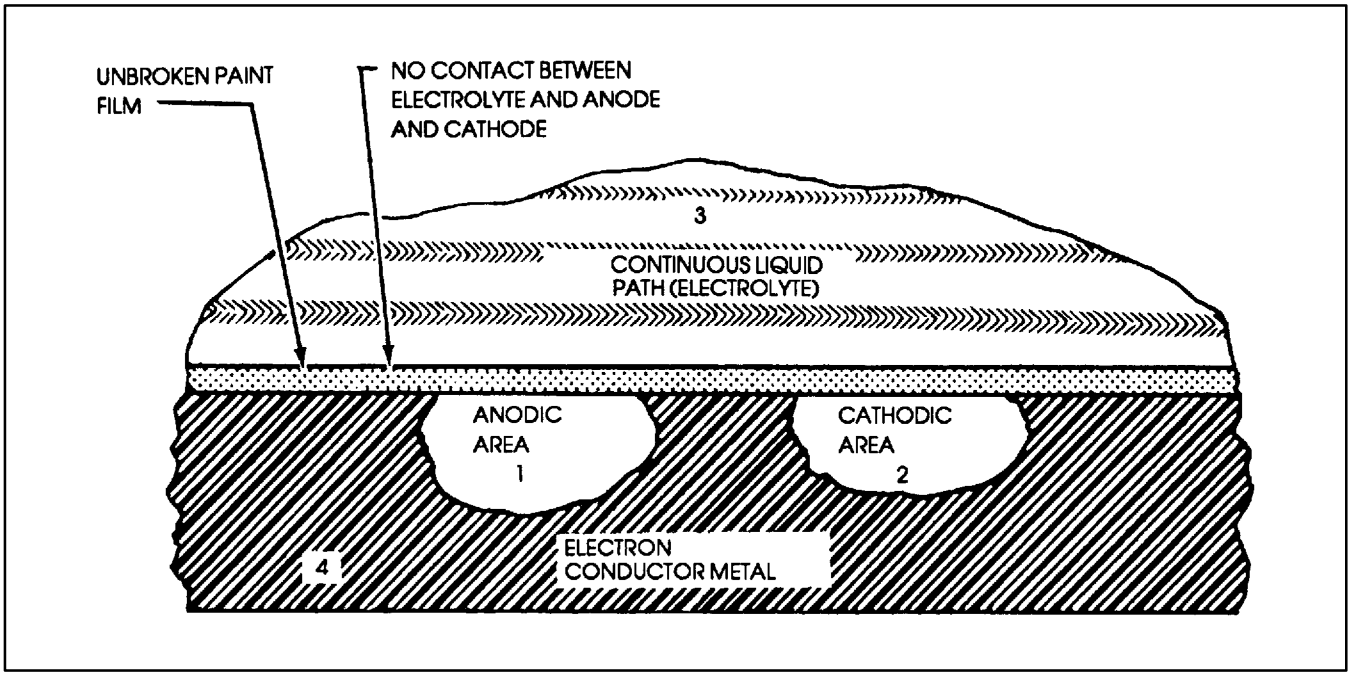


Figure 2-2 Elimination of Corrosion by Application of an Organic Film to a Metal Surface

2-6.1. Type of metal. Most pure metals are not suitable for aircraft construction and are used only in combination with other metals, and sometimes non-metals, to form alloys. Most alloys are made up entirely of small crystalline regions, called grains. Corrosion can occur on surfaces of those regions which are less resistant and also at boundaries between regions, resulting in the formation of pits and intergranular corrosion. The metals most commonly used in aircraft construction are aluminum, steel, titanium, and magnesium. Cadmium, nickel, chromium, and silver are sometimes used as protective platings. Metals have a wide range of corrosion resistance. The most active metals (those which tend to lose electrons easily), such as magnesium and aluminum, corrode easily and are listed at the top of Table 2-1. The most noble metals (those which do not lose electrons easily), such as gold and silver, do not corrode easily and are listed at the bottom of Table 2-1.

2-6.2. Dissimilar metal coupling (galvanic corrosion). When two dissimilar metals make electrical contact in the presence of an electrolyte, the rate at which corrosion occurs depends on the difference in their activities, that is, their positions in Table 2-1. The greater the difference in activity, the faster corrosion occurs. For example, magnesium would corrode very quickly when coupled with gold in a humid atmosphere. But aluminum would corrode very slowly, if at all, in contact with cadmium. A flashlight battery (or dry cell) is an example of galvanic corrosion put to practical use. In Figure 2-4, the zinc battery casing steadily corrodes supplying a steady flow of electrons, but only when the switch is closed. When the switch is open, there is no corrosion because electrons are not able to leave the zinc anode.

2-6.3. Anode and cathode surface area. The rate of galvanic corrosion also depends on the size of the parts in contact. If the surface area of the corroding metal (the anode) is smaller than the surface area of the less active metal (the cathode), corrosion will be rapid and severe. But, when the corroding metal is larger than the less active metal, corrosion will be slow and superficial. For example, an aluminum fastener in contact with a relatively inert monel structure may corrode severely, while a monel bracket secured to a large aluminum member would result in a relatively superficial attack on the aluminum sheet (see Figure 2-5).

Figure 2-3. Effect of Sea Water on Galvanic Corrosion

2-6.4. Temperature. Higher temperature environments tend to produce more rapid corrosion due to accelerated chemical reactions and, in humid environments, higher concentration of water vapor in the air. In addition, nightly drops in temperature can cause greater amounts of condensation, leading to increased corrosion rates.

2-6.5. Heat treatment and grain direction. When heat treated, heavy sections of metals do not cool uniformly and, as a result, tend to vary in chemical composition from one part of the metal to another. This can cause galvanic corrosion if one area is more active than another. Alloys which are fabricated by rolling, extruding, forging, or pressing have properties which depend highly on direction (parallel to grain elongation vs. cross grain). For example, exposed end grain corrodes much more easily than flattened elongated surfaces in sheet stock. This explains why exfoliation occurs at the edge of aircraft skin sections or next to countersunk fasteners.

2-6.6. Electrolytes. Electrically conducting solutions are easily formed on metallic surfaces when condensation, salt spray, rain, or rinse water accumulate. Dirt, salt, acidic stack gases, and engine exhaust gases can dissolve on wet surfaces, increasing the electrical conductivity of the electrolyte, thereby increasing the rate of corrosion.

2-6.7. Oxygen. When some of the electrolyte on a metal surface is partially confined (such as between faying surfaces or in a deep crevice) metal in this confined area corrodes more rapidly than other metal surfaces of the same part outside this area. This type of corrosion is called an oxygen concentration cell or differential aeration cell. Corrosion occurs more rapidly than would be expected, because the reduced oxygen content of the confined electrolyte causes the adjacent metal to become anodic to other metal surfaces on the same part immersed in electrolyte exposed to the air.

2–6.8. Electrolyte concentration. In the same way that metals can corrode when exposed to different concentrations of oxygen in an electrolyte, corrosion will also occur if the concentration of the electrolyte on the surface varies from one location to another. This corrosive situation is known as a concentration cell.

2–6.9. Biological organisms. Slimes, molds, fungi, and other living organisms (some microscopic) can grow on damp surfaces. Once they are well established, the area tends to remain damp, increasing the possibility of corrosion. Their presence can cause the areas they occupy to have different oxygen and electrolyte concentrations. In addition, corrosive wastes are secreted, which cause corrosion.

2–6.10. Mechanical stress. Almost all alloys used in aircraft construction are sensitive to a form of corrosion known as stress corrosion cracking. Manufacturing processes such as machining, forming, welding, or heat treatment can leave stresses in aircraft parts. This residual stress causes corrosion to proceed more rapidly in structurally important regions of the part until failure occurs.

2–6.11. Time. As time goes on, metals naturally tend to corrode. In some cases, the corrosion process occurs at the same rate, no matter how long the metal has been exposed to the environment. In other cases, corrosion can decrease with time, due to the barrier formed by corrosion products, or increase with time if a barrier to corrosion is being broken down.

2–7. TYPES OF CORROSION. Corrosion is catalogued and typed in many ways. Occasionally, different names are used for the same type of corrosion. The common types of corrosion are described below.

2–7.1. Uniform surface corrosion. Uniform surface corrosion results from a direct chemical attack on a metal surface and involves only the metal surface. On a polished surface, this type of corrosion is first seen as a general dulling or etching of the surface and, if the attack is allowed to continue, the surface becomes rough and possibly frosted in appearance. This type of corrosion appears uniform because the anodes and cathodes are very small and constantly shift from one area of the surface to another. An example is the etching of metals by acids. The discoloration or general dulling of metal created by exposure to elevated temperatures is not considered to be uniform surface corrosion.

2–7.2. Galvanic corrosion. Galvanic corrosion occurs when different metals are in contact with each other and an electrolyte, such as salt water. It is usually recognizable by the presence of a buildup of corrosion at the joint between the metals. For example, aluminum skin panels and stainless steel doublers, riveted together in an aircraft wing, form a galvanic couple if moisture and contamination are present. Figure 2–6 shows galvanic corrosion of magnesium adjacent to steel fasteners. When metals which are known to be in electrical contact are well separated from each other in Table 2–1 galvanic corrosion is probably occurring.

2–7.3. Pitting corrosion. The most common corrosion on aluminum and magnesium alloys is called pitting (see Figure 2–7). It is first noticeable as a white or gray powdery deposit, similar to dust, which blotches the surface. When the deposit is cleaned away, tiny pits or holes can be seen in the surface (see Figure 2–8). Pitting corrosion can also occur in other types of alloys. The combination of small active anodes to large passive cathodes cause severe pitting.

2–7.4. Intergranular corrosion. Intergranular corrosion is an attack on the grain boundaries of the metal. A highly magnified cross section of any commercial alloy (see Figures 2–9 and 2–10) shows the granular structure of the metal. It consists of quantities of individual grains, each having a clearly defined boundary, which chemically differs from the metal within the grain. Frequently the grain boundaries are anodic (tend to corrode more easily) to the metal within the grain. When in contact with an electrolyte, rapid corrosion occurs at the grain boundaries. Figure 2–11 shows intergranular corrosion of 7075–T6 aluminum alloy adjacent to steel fasteners. In this example, the grain boundaries are anodic to both the metal grain and the steel fastener.

Table 2-1. Galvanic Series of Metals and Alloys in Sea Water

ANODIC (High Corrosion Potential)
Lithium Magnesium Alloys Zinc (plate) Beryllium Cadmium (plate) Uranium (depleted) Aluminum Alloys Indium Tin (plate) Stainless Steel 430 (active) Lead 1010 Steel Cast Iron Stainless Steel 410 (active) Copper (plate) Nickel (plate) AM 350 (active) Chromium (plate) Stainless Steels 350, 310, 301, 304 (active) Stainless Steels 430 410 (passive) Stainless Steel 13-8, 17-7PH (active) Brass, yellow, Naval Stainless Steel 316L (active) Bronze 220 Copper 110 Stainless Steel 347 (active) Copper-Nickel 715 Stainless Steel 202 (active) Monel 400 Stainless Steel 201 (active) Stainless Steels 321 316 (active) Stainless Steels 309 13-8 17-7 PH (passive) Stainless Steels 304, 301 321 (passive) Stainless Steels 201 31 6L (passive) Stainless Steel 286 (active) AM355 (active) Stainless Steel 202 (passive) Carpenter 20 (passive) AM355 (passive) Titanium Alloys AM350 (passive) Silver Palladium Gold Rhodium Platinum Carbon/Graphite
CATHODIC (Low corrosion potential)

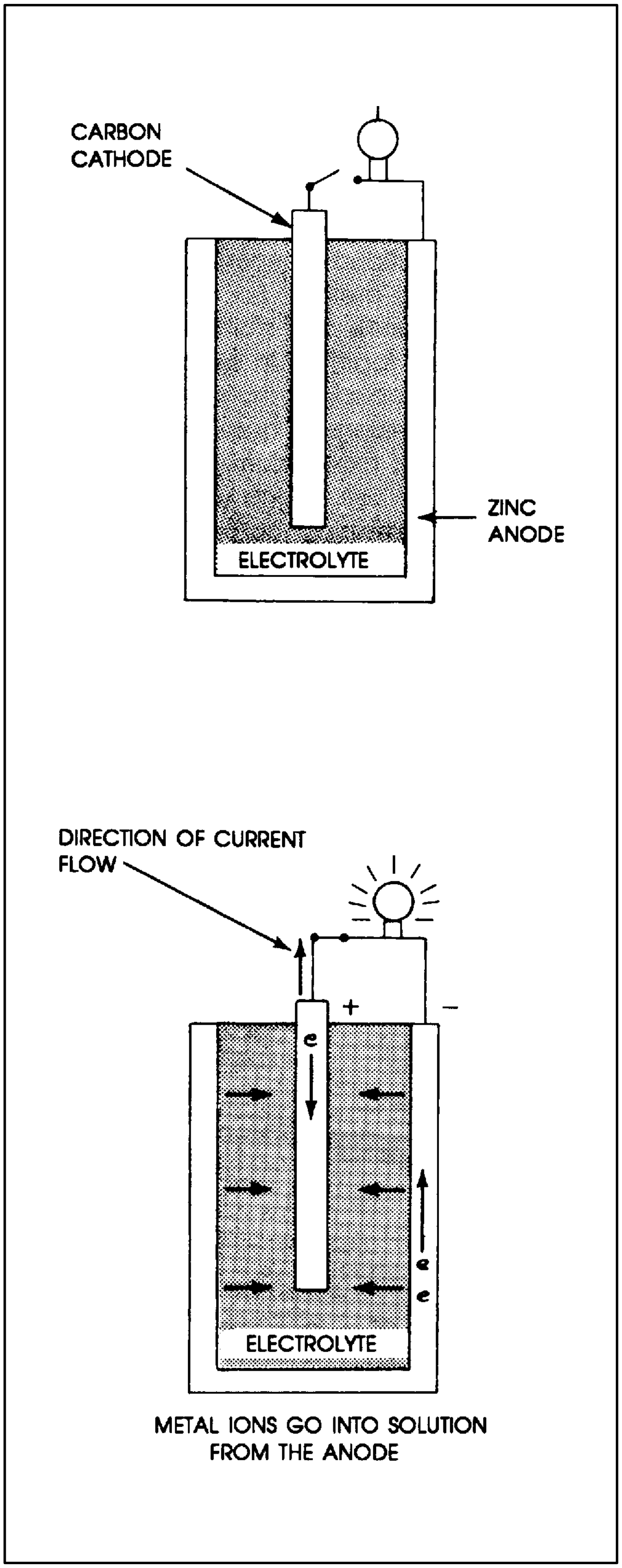


Figure 2-4. Galvanic Corrosion in a Flashlight Battery

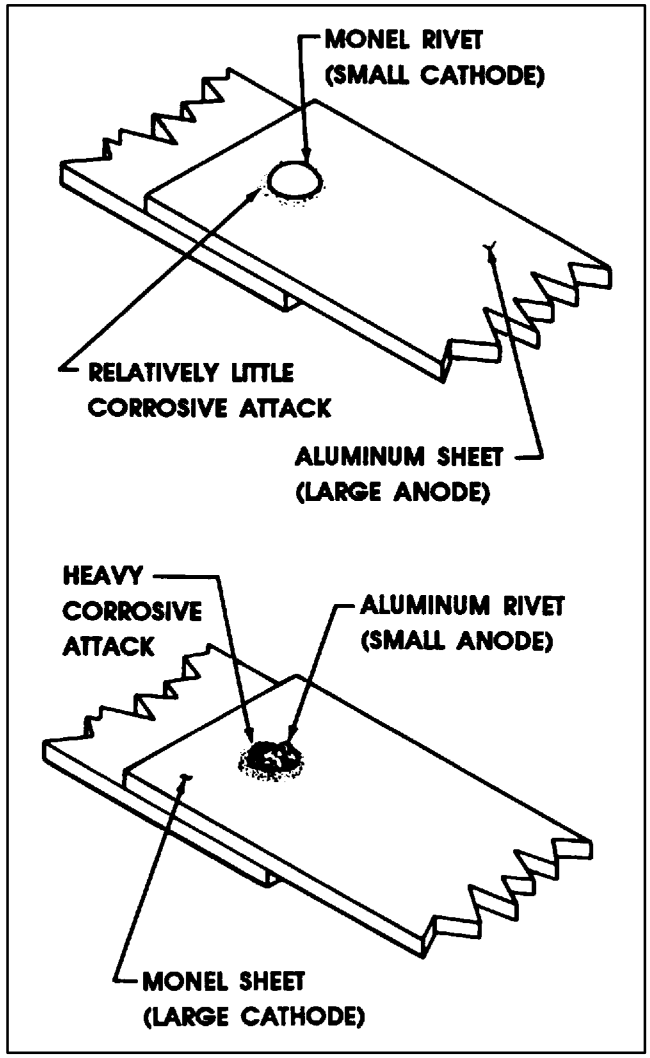


Figure 2-5. Effect of Area Relationship in Dissimilar Metal Contacts

2-7.5. Exfoliation corrosion. Exfoliation (see Figures 2-11 and 2-12) is an advanced form of intergranular corrosion where the surface grains of a metal are lifted up by the force of expanding corrosion products occurring at the grain boundaries. The lifting up or swelling is visible evidence of exfoliation corrosion. Exfoliation occurs on extruded, rolled, wrought, and forged high strength aluminum and magnesium parts.

2-7.6. Crevice/concentration cell corrosion. Crevice corrosion occurs when the electrolyte has a different concentration from one area to another. Electrolyte inside the

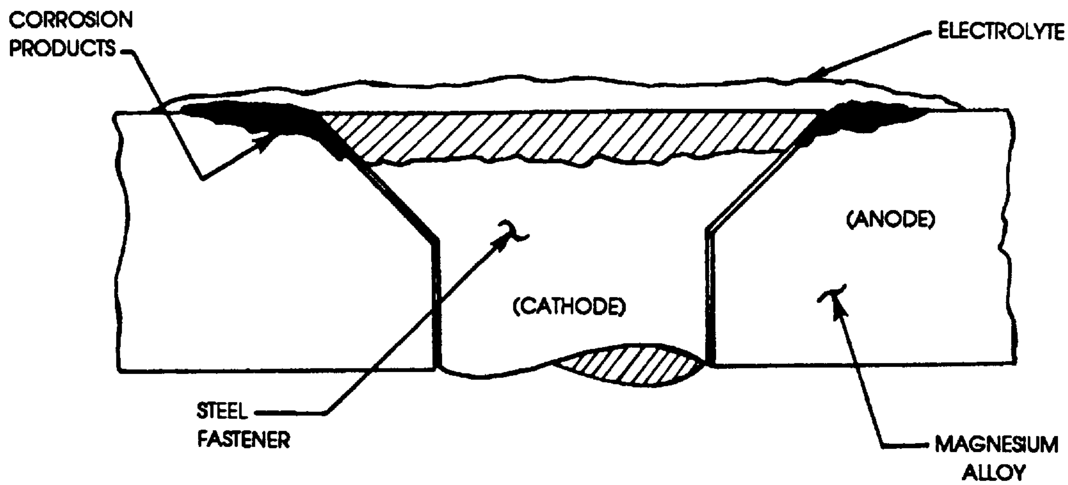


Figure 2-6. Galvanic Corrosion of Magnesium Adjacent to Steel Fastener

crevice contains less oxygen and more metal ions than electrolyte just outside the crevice. As a result, the metal surfaces, even though they may be part of the same metal, have different activities and corrosion occurs inside the crevice. This kind of corrosion also occurs when a surface is covered by a foreign material. There are three general types of crevice/concentration cell corrosion (1) metal ion concentration cells; (2) oxygen concentration cells; and (3) active-passive cells (Figure 2-14).

2-7.6.1. Metal ion concentration cells. Stagnant electrolytes under faying surfaces will normally have a high concentration of metal ions while a low concentration of metal ions will exist adjacent to the crevice created by the faying surface. The area of the metal in contact with the higher concentration of metal ions will be cathodic and not show signs of corrosion but the area in contact with the lower metal ion concentration will be anodic and suffer corrosion. Figure 2-14, view A, illustrates metal ion concentration cell corrosion.

2-7.6.2. Oxygen concentration cells. Electrolyte in contact with metal surfaces will normally contain dissolved oxygen. An oxygen cell can develop at any point where the oxygen in the air is not allowed to diffuse into the solution, thereby creating a difference in oxygen concentration between two points. Typical locations of oxygen concentration cells are under either metallic or non-metallic deposits (dirt) on the metal surface and under faying surfaces such as riveted lap joints. Oxygen cells can also develop under gaskets, wood, rubber, plastic tape, and other materials in contact with the metal surface. Corrosion will occur at the area of low oxygen concentration (anode) as illustrated Figure 2-14, view B. Alloys such as stainless steel, which owe their corrosion resistance to surface passivity, are particularly susceptible to this type of crevice/concentration cell corrosion.

2-7.6.3. Active/passive cells. Metals which depend on a tightly adhering passive film, such as the oxide film on corrosion resistant steel, are prone to rapid corrosive attack by active-passive cells. The corrosive action usually starts with a deposit of dirt or salt which creates an oxygen concentration cell. The passive film is then broken in the area of the salt deposit and the more active metal beneath the passive film will be exposed to corrosive attack. This small anodic area will then corrode rapidly due to the much larger area of the surrounding cathode (passive film). The result is rapid pitting of the surface, as illustrated in Figure 2-14, view C.

Figure 2–7. Pitting of an Aluminum Wing Assembly

2–7.7. Stress corrosion cracking. Stress corrosion cracking (Figure 2–15) is the inter–granular or transgranular cracking of a metal caused by the combined effects of constant tensile stress (internal or applied) and corrosion. Internal or residual stresses are produced by cold working, forming, and heat treatment operations during manufacture of a part and remain concealed in the part unless stress relief operations are used. Other hidden stresses are induced in parts when press or shrink fits are used and when slightly mismatched parts are clamped together with rivets and bolts. All these stresses add to those caused by applying normal loads to parts in operation. Metals have threshold stresses below which stress corrosion cracking will not occur. This threshold stress varies from metal to metal, is different for different tempers of the same metal, and is different for each of the three directions in which stress can be applied.

2–7.7.1. Associated hazards. Stress corrosion cracking is an extremely dangerous type of failure because it can occur at stress levels far below the rated strength of a metal, starting from what is thought to be a very minor corrosion pit. Parts can completely sever in a split second or they can crack slowly, and the rate of cracking is very unpredictable in operating service. As an example, 7075–T6 aluminum alloy can fail by stress corrosion cracking when a stress which is only 10% of its rated strength is present across the thickness of its metal grains.

2–7.7.2. Causes. Specific environments have been identified which cause stress corrosion cracking of certain alloys. Salt solutions, sea water, and moist salt laden air may cause stress corrosion cracking of heat treatable aluminum alloys, stainless steels, and some titanium alloys. Magnesium alloys may stress corrode in moist air. Stress corrosion can be prevented by placing an insulating barrier between the metal and the corrosive environment by applying protective coatings and water displacing corrosion preventive compounds. Stress relief operations during fabrication of parts will help, because it lowers the stress level on the parts. Shot peening a metal increases resistance to stress corrosion cracking by creating compressive stresses on the surface, which must be overcome by an applied tensile stress before the surface sees any tension load.

2–7.8. Corrosion fatigue. Corrosion fatigue is the cracking of metals caused by the combined effects of cyclic stress and corrosion, and is very similar to stress corrosion cracking. No metal is immune to some reduction in its resistance to cyclic stressing if the metal is in a corrosive environment. Damage from fatigue corrosion is greater than the sum of the damage from both cyclic stresses and corrosion. Corrosion fatigue failure occurs in two stages. During the first stage, the combined action of corrosion and cyclic stress damages the metal by pitting and crack formation in the pitted area. The second stage is the continuation of crack propagation by a straight fatigue mode, in which the rate of cracking is controlled by: (a) stress concentration in the main cross section; and (b) the physical properties of the metal. Fracture of a metal part due to corrosion fatigue occurs at a stress far below the fatigue limit even though the amount of corrosion is unbelievably small. For this reason, protection of all parts subject to alternating stress is particularly important, even in environments that are only mildly corrosive. Preventive measures are the same as those given above for stress corrosion cracking.

2–7.9. Filiform corrosion. Filiform corrosion (see Figure 2–16) is a special form of oxygen concentration cell corrosion or crevice corrosion which occurs on metal surfaces having an organic coating system. It is recognized by its characteristic wormlike trace of corrosion products beneath the paint film. Filiform occurs when the relative humidity of the air is between 78 and 90% and when the surface is slightly acidic. It starts at breaks in the coating system, such as scratches and cracks around fasteners and seams, and proceeds underneath the coating, due to the diffusion of water vapor and oxygen from the air through the coating (see Figure 2–17). Filiform corrosion can attack steel, magnesium, and aluminum surfaces and may lead to more serious corrosion in some locations. Filiform corrosion can be prevented by storing equipment and aircraft in an environment with a relative humidity below 70%, by using coating systems having a low rate of diffusion for oxygen and water vapors, by maintaining coatings in good condition, and by washing equipment and aircraft to remove acidic contaminants from the surface (such as those created by pollutants in the air). Maintain coatings in good condition (prompt touchup around fasteners) and apply corrosion preventive compounds (CPC's) when paint is damaged.

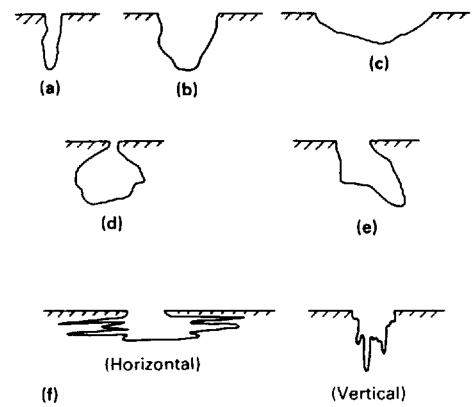
2–7.10. Fretting corrosion. This is a special form of concentration cell corrosion, which occurs in combination with surface wear. The corrosion products increase the wear of the surface and the wear exposes more bare metal surface to be corroded. The overall effect is greater than the single effects of corrosion and wear added together. It has the general appearance of galling, in which chunks of metal are torn from the surface with corrosion at the torn areas or ragged pits. This type of corrosion occurs on faying surfaces of close tolerance and on parts under high pressure in a corrosive environment when there is slight relative movement of the parts, such as that caused by vibration. Fretting corrosion is normally encountered in heavily loaded static joints which are subject to vibration and are not and/or cannot be sealed to prevent moisture entry, such as landing gear component attachment areas having lug holes with slight press fits or slip fit bushings with very close tolerance bolts passing through the bushings. Another area is wing root access panels or wing–to–body fairings, which are generally not tightly secured and cannot be sealed in faying surfaces.

2–7.11. High temperature oxidation (hot corrosion). Corrosion in the absence of water can occur at high temperatures, such as those found in turbine engine compressors and hot sections. When hot enough, metals can react directly with the surrounding gases producing oxide scale (by–products of oxidation). Contaminants, such as chlorides and sulfates (by–products of sulfidation), can accelerate the hot corrosion reaction by reducing the melting point of the metallic oxide and promoting its vaporization. High temperature ceramic coatings can reduce this type of corrosion but are usually applied only by the manufacturer due to highly specialized equipment required for application.

2–8. METALS AFFECTED BY CORROSION. The characteristics of corrosion on aircraft metals are summarized in Table 2–2. The following is a discussion of corrosion characteristics of commonly used aircraft metals.

2–8.1. Magnesium. Magnesium alloys are the lightest structural metals used for aircraft and missile airframes. These alloys are highly susceptible to corrosion, which appears as white, powdery mounds or spots when the metal surface is exposed to the environment without a protective finish (see Figure 2–18). The normal oxide–carbonate film formed on magnesium alloys does not provide sufficient corrosion protection even in the mildest environment. The rate of corrosion of a magnesium alloy increases when the alloy is immersed in water or periodically subjected to moisture. Corrosion may also be accelerated by dissimilar metal couples and when conductive contaminants are dissolved in the water. Corrosion of magnesium alloys can be greatly diminished by the use of the proper protective finish, such as magnesium conversion coating and paint. Some magnesium parts in current aircraft have been originally protected by anodizing processes, such as HAE and Dow #17 coatings. The HAE process can be identified by the brown to mottled gray appearance of the unpainted surface. Dow #17 anodized coatings have a green to grayish-green color. Coatings of this type are thicker than those applied by immersion or brush on conversion coating. Anodized finishes cannot be restored in the field. Care should be taken to minimize removal of these coatings.

2-8.2. Steel. Ferrous (Iron) alloys are used to manufacture many aircraft components and massive structures and assemblies in aircraft ground support equipment, such as missile gantries, silo crib structures, frames and bodies of trailers and vans, and lesser structural parts such as brackets, racks, and panels. If unprotected, ferrous alloy surfaces (with the exception of stainless steels) are easily corroded in the presence of moisture. Ferrous alloy surfaces of structures or assemblies are normally painted or plated and painted to prevent corrosion. Corrosion of steel is easily recognized because the corrosion product is red rust (Figure 2-19). When ferrous alloys corrode, a dark corrosion product usually forms first. When moisture is present, this coating is converted to red rust, which will promote further attack by absorbing moisture from the air.



Variations in the cross-sectional shape of pits.
(a) Narrow and deep. (b) Elliptical. (c) Wide and shallow. (d) Subsurface. (e) Undercutting. (f) Shapes determined by microstructural orientation.

Figure 2-8. Cross-section of Corrosion Pits

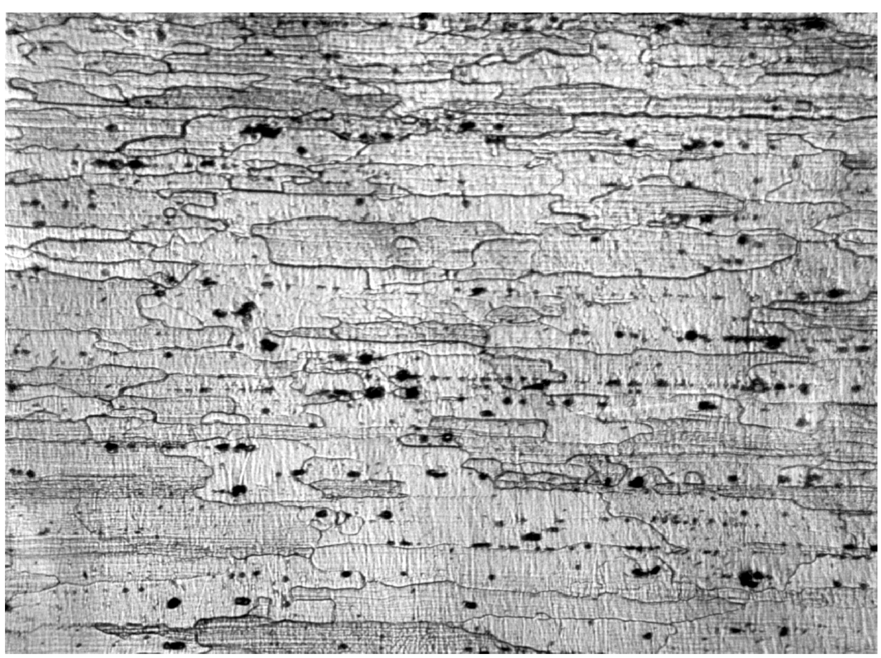


Figure 2-9. Cross-section of 7075-T6 Aluminum Alloy

Table 2–2. Corrosion of Metals – Type of Attack and Appearance of Corrosion Products

Alloys	Type of Attack to Which Alloy Is Susceptible	Appearance of Corrosion Product
Magnesium Alloy	Highly susceptible to pitting	White, powdery, snowlike mounds, and white spots on surface
Low Alloy Steel (4000–8000 series)	Surface oxidation and pitting; surface and intergranular corrosion	Reddish–brown oxide (rust)
Aluminum Alloy	Surface pitting, intergranular, exfoliation, stress corrosion and fatigue cracking, and fretting	White to gray powder
Titanium Alloy	Highly corrosion resistant; extended or repeated contact with chlorinated solvents may result in degradation of the metal's structural properties	No visible corrosion products at low temperature. Colored surface oxides develop above 700_F (370_C)
Cadmium (used as a protective plating for steel)	Uniform surface corrosion; used as sacrificial plating to protect steel	From white powdery deposit to brown or black mottling of the surface.
Stainless Steels (300–400 series)	Crevice/concentration cell corrosion; some pitting in marine environments; corrosion cracking; intergranular corrosion (300 series); surface corrosion (400 series)	Rough surface; sometimes a red, brown, or black stain.
Nickel–base Alloy (Inconel, Monel)	Generally has good corrosion resistant qualities; susceptible to pitting in sea water	Green powdery deposit
Copper–base Alloy, Brass, Bronze	Surface and intergranular corrosion	Blue or blue–green powdery deposit
Chromium (plate)	Pitting (promotes rusting of steel where pits occur in plate)	No visible corrosion products; blistering of plating due to rusting and lifting.

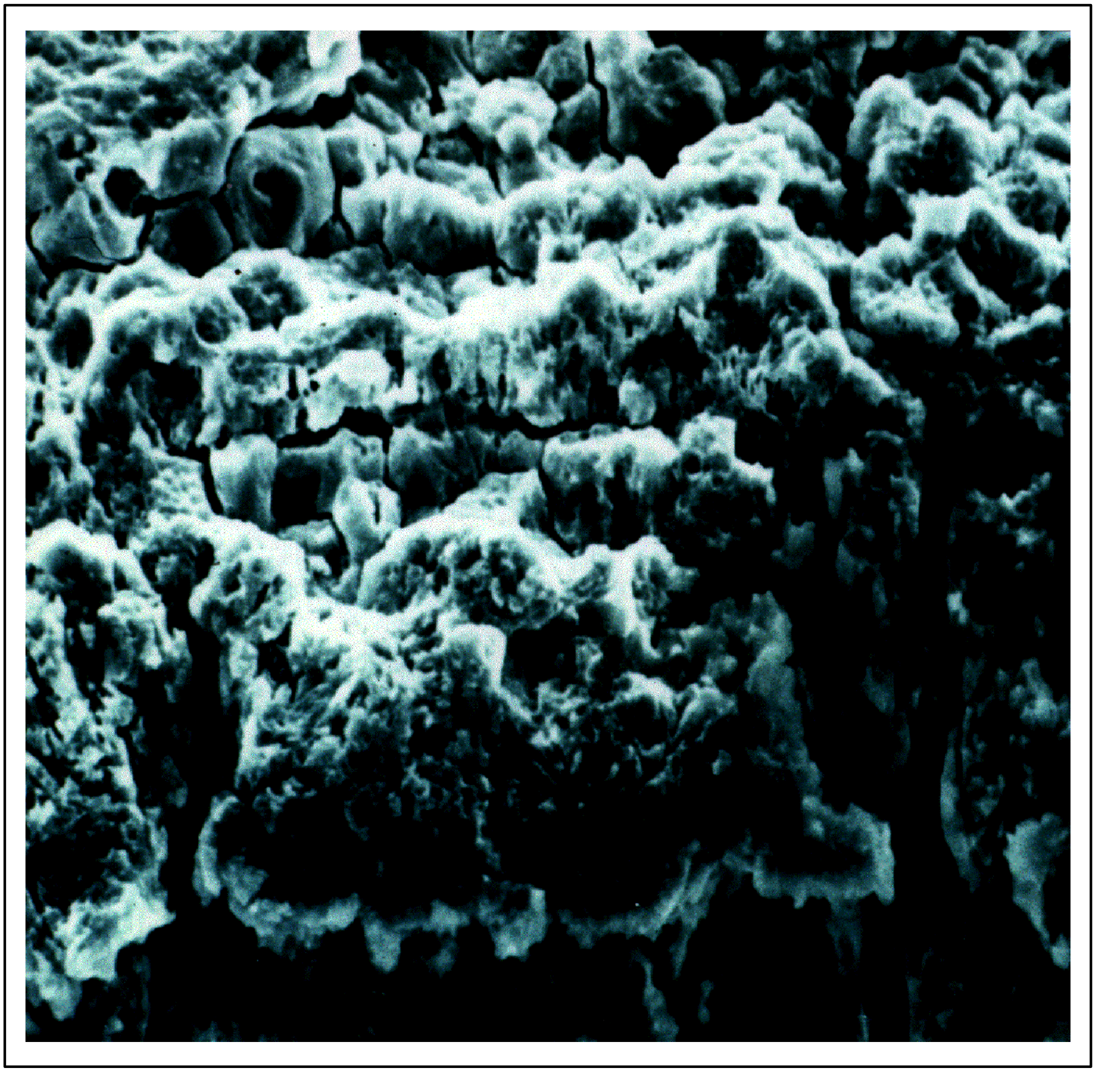


Figure 2–10. Grain Structure of a Corroding Aluminum Surface

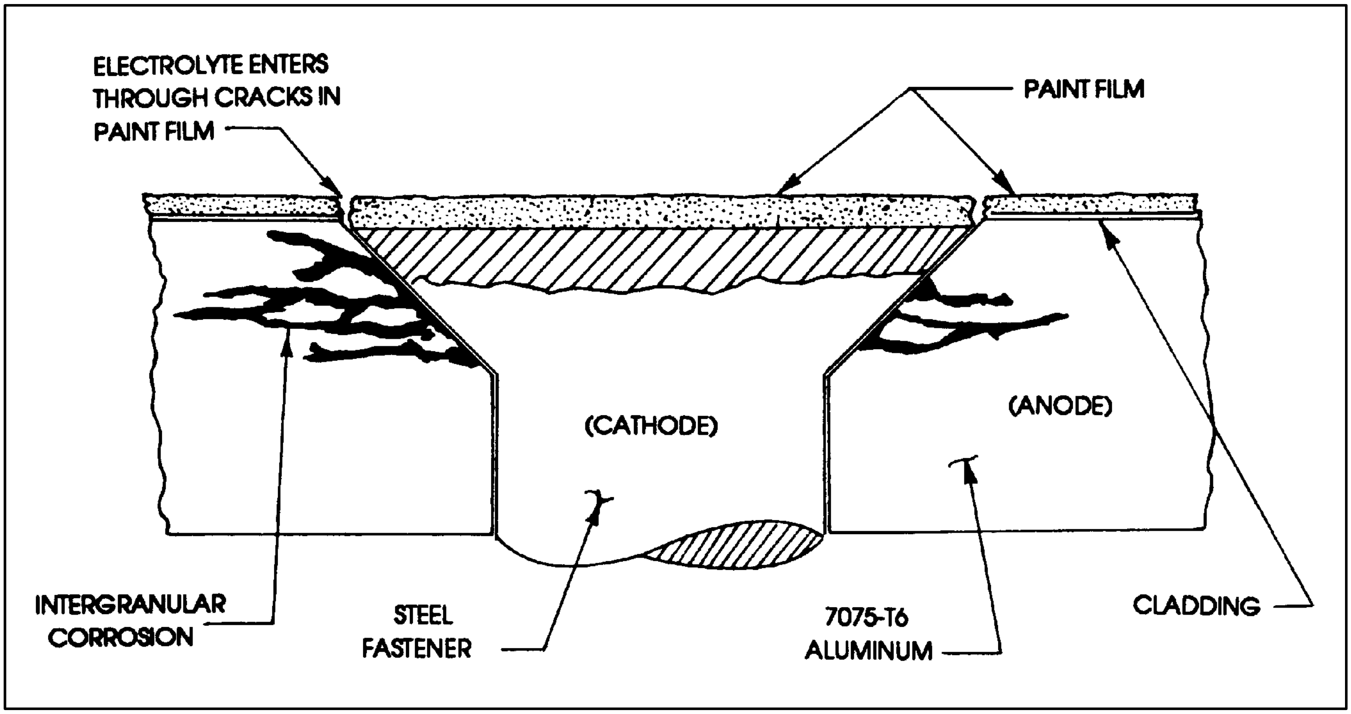


Figure 2-11. Intergranular Corrosion of 7075-T6 Aluminum Adjacent to Steel Fasterner

Figure 2-12. Extreme Example of Exfoliation

Figure 2-13. Exfoliation

2-8.3. Aluminum. Aluminum and alloys of aluminum are the most widely used materials for aircraft construction. Aluminum is highly anodic as evidenced by its position in the galvanic series table. However, the formation of a tightly adhering oxide film offers increased resistance under mild corrosive conditions. The corrosion product of aluminum is a white to gray powdery material (aluminum oxide or hydroxide) which can be removed by mechanical polishing or brushing with abrasives (Figure 2-20). It is anodic to most other metals, and, when in contact with them, galvanic corrosion of the aluminum will occur. Aluminum alloys are subject to pitting, intergranular corrosion, and intergranular stress corrosion cracking. In some cases, the corrosion products of a metal in contact with aluminum are corrosive to aluminum. Therefore, it is necessary to clean and protect aluminum and its alloys against corrosion. Since pure aluminum is more corrosion resistant than most alloys, aluminum sheet stock is often covered with a thin layer of nearly pure aluminum called cladding or alclad. Cladding is easily removed by harsh treatment with abrasives and tooling, exposing a more corrodible surface. In such areas, chemical conversion coat, paints and corrosion preventive compounds are especially important. However, in a marine environment, all aluminum surfaces require protection.

2-8.4. Anodized aluminum. Some aluminum parts are protected with an electrochemically applied oxide coating (i.e, anodize). Aluminum oxide film on aluminum is a naturally occurring protective film, and anodizing merely increases the thickness of the oxide film. When this coating is damaged in service, it can be only partially restored by chemical surface treatment (Chapter 5, Section II). Avoid unnecessary destruction (e.g. nicks and scratches) of the anodized surface during processing of anodized aluminum.

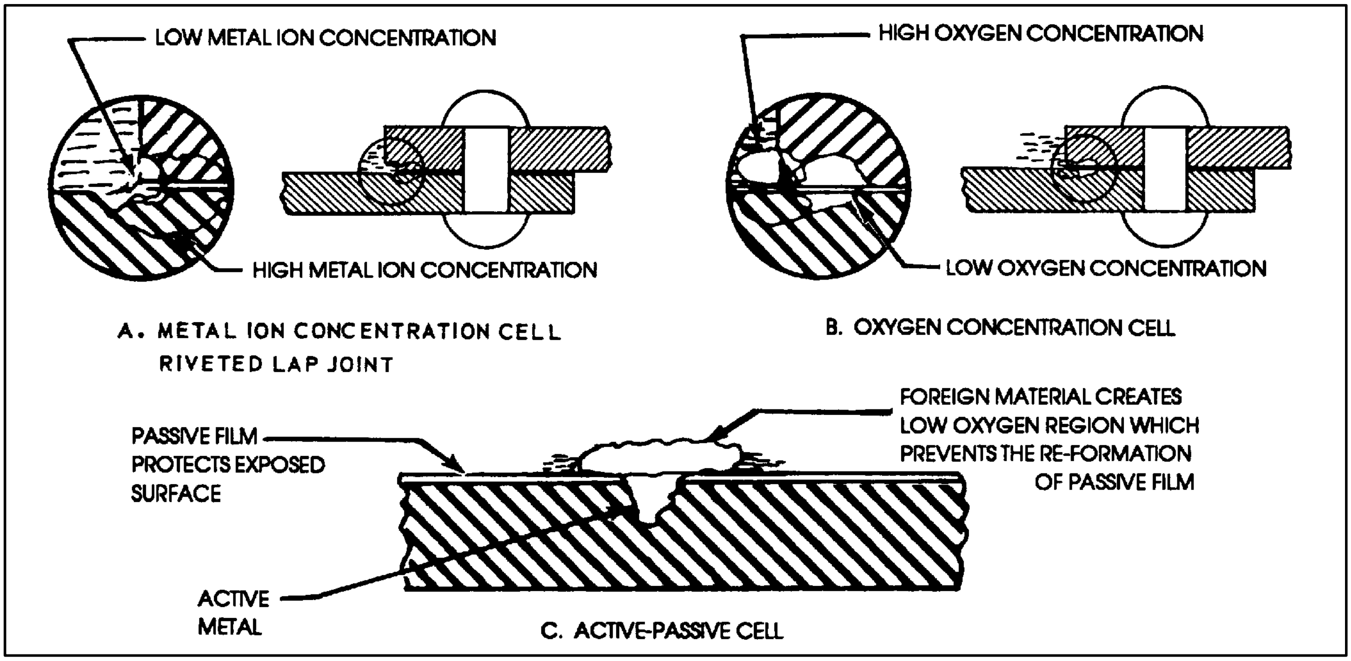


Figure 2-14. Concentration Cell Corrosion

2-8.5. Titanium. Titanium and titanium alloys find numerous uses in aircraft and missiles at temperatures up to 1000_F (540_C). Above 1000_F, titanium readily absorbs gases from the surrounding air becoming very brittle. Titanium and its alloys are highly corrosion resistant, because an oxide film forms on their surfaces almost immediately upon contact with air, which is extremely adherent to the surfaces and thus provides a protective barrier. This is identical to the way aluminum forms a protective oxide film on its surface. Even at temperatures approaching 1000_F, titanium retains its strength and corrosion resistance. When titanium is heated, different oxides having different colors form on the surface. A blue oxide coating will form at 700_ to 800_F (370_ to 425_C), a purple oxide will form at 800_ to 950_F (425_ to 510_C), and a gray or black oxide will form at 1000_F (540_C) or higher. These are protective discolorations and should not be removed. Titanium is the less active member (cathodic) of most dissimilar metal couples, but can greatly accelerate corrosion of a dissimilar metal coupled to it. Electrical insulation between titanium and other metals is necessary to prevent galvanic corrosion of the other metal. Frequent inspection of such areas is required to insure that insulation failure has not allowed corrosion to begin. Under certain conditions, chlorides and some chlorinated solvents may induce stress corrosion cracking of certain titanium alloys.

2-8.6. Copper and copper alloys. Copper and copper alloys are quite corrosion resistant with corrosion usually limited to staining and tarnish. Generally, such changes in surface conditions are not dangerous and should ordinarily have no effect on the part. Copper corrosion is evidenced by the accumulation of blue or blue-green corrosion products on the corroded part. Protective paint coatings are seldom required because of the inherent resistance of the metal. However, paint finishes may be applied for decorative purposes or if the normal tarnish or green patina on the copper is objectionable. The green patina is merely a thin coating consisting mainly of basic copper sulfate and perhaps hydrated copper carbonate. The patina in the thin, firmly adhering state actually offers increased corrosion protection to the base metal, but the patina in a rough or frosted state should be removed. When coupled with most metals used in aircraft construction, copper is the less active metal and greatly accelerates corrosion of the other metals. This is especially true in copper/aluminum couples. Examples are usually found in electrical components and in areas where copper bonding strips or wires are fastened to an aluminum chassis or structural components.

2-8.7. Cadmium. Metal parts are plated either to increase the corrosion resistance of the parts or to develop certain physical properties on the surface of the ports, such as abrasion (wear) resistance and high temperature oxidation resistance. Parts may also be plated to eliminate dissimilar metal contact to provide a satisfactory surface for soldering or to provide a sacrificial metal layer. Cadmium is used as a coating to protect metal parts and to provide a compatible surface when a part is in contact with other materials. Attack on cadmium is evidenced by brown to black mottling of the surface or as white powdery corrosion products. When cadmium shows mottling and isolated voids or cracks in the coating, the plating is still performing its protective function. The cadmium plate on iron or steel continues to protect until such time as actual iron rust appears (Figure 2-21). Even then, any mechanical removal of corrosion products should be limited to metal surfaces from which the cadmium has been depleted.

Figure 2-15. Stress Corrosion Cracking

2-8.8. Stainless steel. Basically, stainless steels, or corrosion resistant steels, as they are more properly described, are alloys of iron with chromium. Many other elements, such as nickel, sulfur, molybdenum, vanadium, cobalt, columbium, titanium, and aluminum are added in various amounts and combinations to develop special characteristics. Stainless steels are much more resistant to common rusting, chemical action, and high temperature oxidation than ordinary steels, due to the formation of an invisible oxide film or passive layer on the surface of these alloys. Corrosion and heat resistance are the major factors in selecting stainless steels for a specific application. However, it should be well understood that stainless steels are not the cure-all for all corrosion problems, due to service conditions which can destroy the oxide film on their surfaces. Stainless steels are highly susceptible to crevice/concentration cell corrosion and stress corrosion cracking in moist, salt laden environments and can cause galvanic corrosion of almost any other metal with which they are in contact if proper techniques of sealing and protective coating are ignored. Stainless steels may be magnetic or non-magnetic. The magnetic steels are identified by numbers in the American Iron and Steel Institute (AISI) 400-Series, such as 410, 430, etc. These steels are not as corrosion resistant as the non-magnetic steels, which are identified by numbers in the AISI 300-Series, such as 304, 316, etc. The AISI 300-Series steels have nickel contents ranging from 6% to 22%, while the 400-Series steels have nickel contents of only 2%.

2-8.9. Nickel and chromium. Nickel and chromium are used as protective platings. Chromium plating is also used to provide a smooth, wear-resistant surface and to reclaim worn parts. Where corrosion resistance in a marine environment is required, a nickel under-coat is used. The degree of protection is dependent upon plating thickness. Both of these metals form continuous oxide coatings that can be polished to a high luster and still protect not only themselves but any underlying metal. Chromium coatings contain cracks, and corrosion originates at the base metal below these separations. Figure 2-22 shows the results of a failed chromium plate.

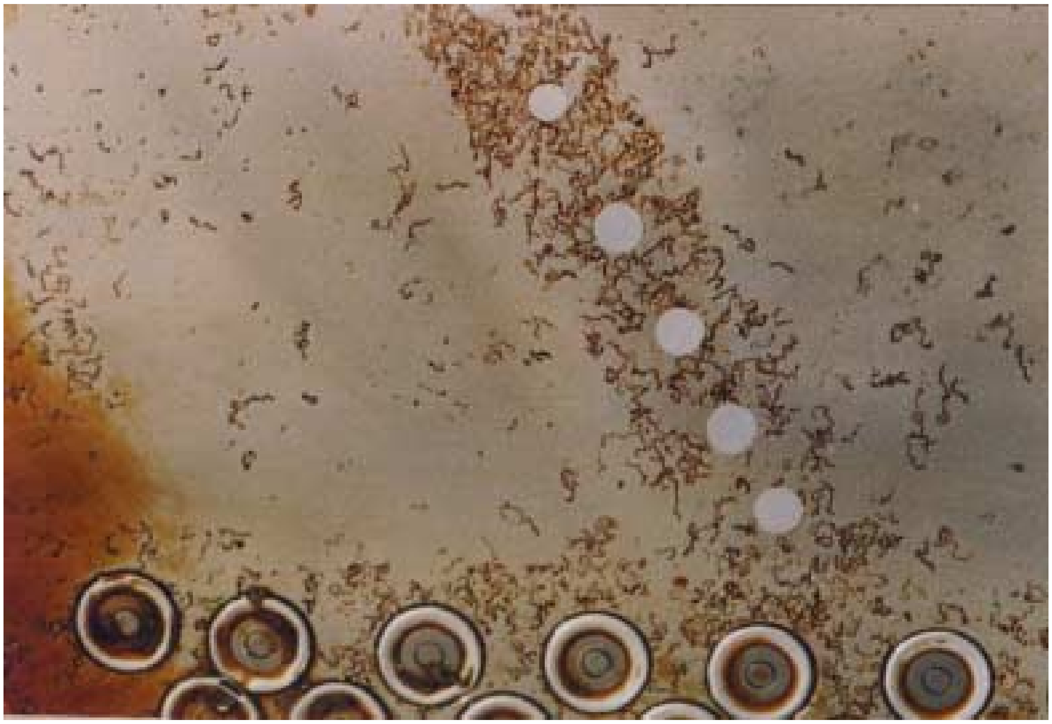


Figure 2-16. Filiform Corrosion Found Under Paint Coating on a Magnesium Panel

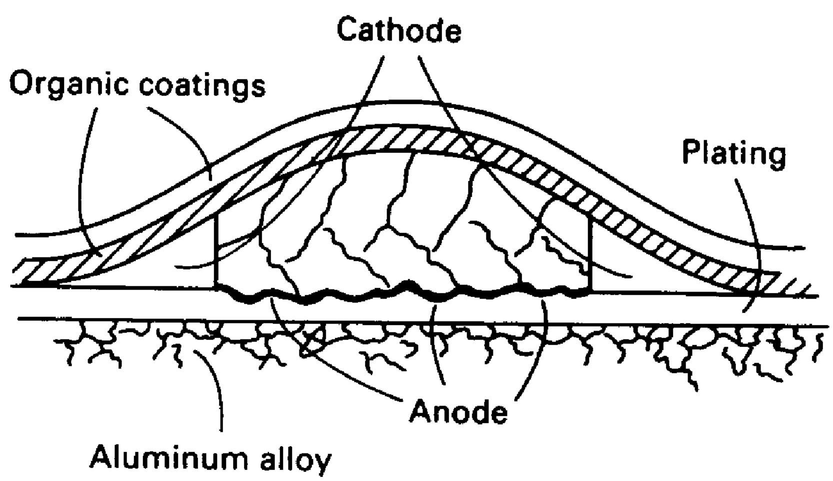


Figure 2-17. Schematic of the Development of Filiform Corrosion on an Aluminum Alloy.

Figure 2-18. Magnesium Corrosion Products

2-8.10. Silver, platinum, and gold. These metals do not corrode in the ordinary sense, although silver tarnishes in the presence of sulfur. The tarnish is a brown-to-black film. Gold tarnish is very thin and shows up as a darkening of reflecting surfaces.

2-8.11. Graphite/carbon fiber composites. Graphite or carbon fiber composites are materials which consist of reinforcing fibers in a matrix made of organic resin, usually epoxy. They are an important class of aviation materials because of their high strength-to-weight ratios and high stiffness. Since carbon is the least active metal in the galvanic series, it will accelerate the corrosion of any aircraft metal to which it is coupled. Insulation between graphite or carbon epoxy composites and other metals is necessary to prevent dissimilar metal attack on the attached part.

2-9. CORROSIVE ENVIRONMENTS. Corrosion of aviation equipment is caused by both natural and man-made environments. Natural conditions which affect the corrosion process are moisture, temperature, salt atmospheres, ozone, sand, dust, solar radiation, insects and birds, and microorganisms. Man-made conditions, which also affect the corrosion process, are industrial pollution, manufacturing operations, storage conditions, and shipment. By understanding these conditions, maintenance personnel will be better able to prevent aircraft damage.

2-9.1. Moisture. Moisture is present in air as a gas (water vapor) or as finely divided droplets of liquid (mist or fog) and often contains contaminants such as chlorides, sulfates, and nitrates, which increase its corrosive effects. Moisture enters all areas of an aircraft that air can enter. All enclosed areas which are not sealed allow air to enter and leave as the difference in pressure between inside and outside changes. These pressure differences occur when the aircraft changes altitude, when atmospheric pressure changes, and when the temperature of air inside an enclosed area changes. Moisture will condense out of air when the air becomes too cool to hold all of the moisture in it. The dew found on aircraft after a cool night is the result of condensation.

2-9.1.1. Condensed moisture. Condensed moisture will usually evaporate as surrounding air warms but will leave its contaminants (residues), including salts, behind. This can result in the build-up of soils and salt contamination.

Condensed moisture and its contaminants can also be trapped in close fitting wettable joints, such as faying surfaces. Some gasket and packing materials will absorb several times their weight in water and, when heated, can transmit this retained moisture into the sealed area. Moisture can accumulate in such areas through successive cycles of warming and cooling. In addition, moisture can be drawn along poor bond lines by capillary action (wicking). Conditions of temperature and humidity can vary widely in separate sections of aircraft depending on the success of environmental sealing condensation, and location near heat-generating equipment.

2-9.1.2. Effect of moisture. Electrolyte formation results from condensation of moisture. All non-metals absorb some moisture which may cause changes in dimensional stability, dielectric strengths, ignition voltages, and volume insulation resistances. In general, organic matrix composites are adversely affected by moisture and may suffer a loss of strength and stiffness from exposure. Hermetic sealing (liquid and vapor proof at normal temperatures and pressures) is recommended for moisture-critical items such as capacitors and quartz crystals. Refer to NAVAIR 16-1-540 (Navy), T.O. 1-1-689 (Air Force), or TM 55-1500-343-23 (Army) for additional information.

2-9.2. Temperature. Temperatures at the high end of the range for which equipment is designed may result in either improvement or degradation of equipment, depending on conditions. Some electronic equipment may not function properly at high temperatures. Generally, corrosion and other harmful processes (such as the degradation of non metallic materials) increase as temperatures rise, but in some instances, moderate increases in temperature may serve to reduce corrosion by preventing condensation. Mold and bacteria growth are also inhibited by temperatures above 104_ F (40_ C). Temperatures at the low end of the design range generally reduce the rate of corrosion.

2-9.3. Salt atmospheres. When dissolved in water, salt particles form strong electrolytes. The ocean, which carries from 3.5 to 3.9% salt, is the world's primary source of salt. Normal sea winds carry from 10 to 100 pounds of sea salt per cubic mile of air. Since dissolved salts are strong electrolytes, it is easy to understand why shipboard and coastal environments are highly corrosive.

2-9.4. Ozone. Ozone is a particularly active form of oxygen which is formed naturally during thunderstorms, by arcing in electrical devices, and by photo-chemical reactions in smog. When ozone is absorbed by electrolyte solutions in contact with metals, it increases the rate of corrosion. It also oxidizes many nonmetallic materials, being particularly harmful to natural and certain types of synthetic rubber. Rubber seals stored near welding equipment have experienced complete degradation.

2-9.5. Other industrial pollutants. Carbon (from internal combustion engine exhaust), nitrates (from agricultural fertilizers), ozone (from electrical motors and welding operations), sulfur dioxide (from engine exhaust and industrial and ship smoke stacks), and sulfates (from automobile exhaust) are important airborne pollutants. The combination of these pollutants contributes to the deterioration of non-metallic materials and severe corrosion of metals.

2-9.6. Sand, dust, and volcanic ash. Sand, dust, and volcanic ash are present in many areas, but particularly in industrial areas where they often contain a number of tar products, ashes, and soot. Dust is also found in the tropic zones during times of little or no rainfall. Sand and dust are extreme problems in the deserts, since dry, powdery sand and dust are carried by wind. During sandstorms, they can penetrate sealed equipment as well as many internal areas of airframes. In arid regions such as deserts, small sand particles are often blown as high as 10,000 feet by the siroccos (hot, dust laden winds). Sand, dust and volcanic ash are hygroscopic and, when present on internal or external surfaces of aircraft or electronic parts, can absorb and hold moisture. The presence of sand, dust and volcanic ash may also effect the operation of electrical contacts, prevent proper action of rotating motor-drive devices, and cause malfunctions of indicating instruments. Dust from volcanic areas contain chlorides and sulfates, which are extremely corrosive in the presence of moisture. Although small amounts of sand or dust may be unnoticed by operating personnel, they may be sufficient to promote corrosion.

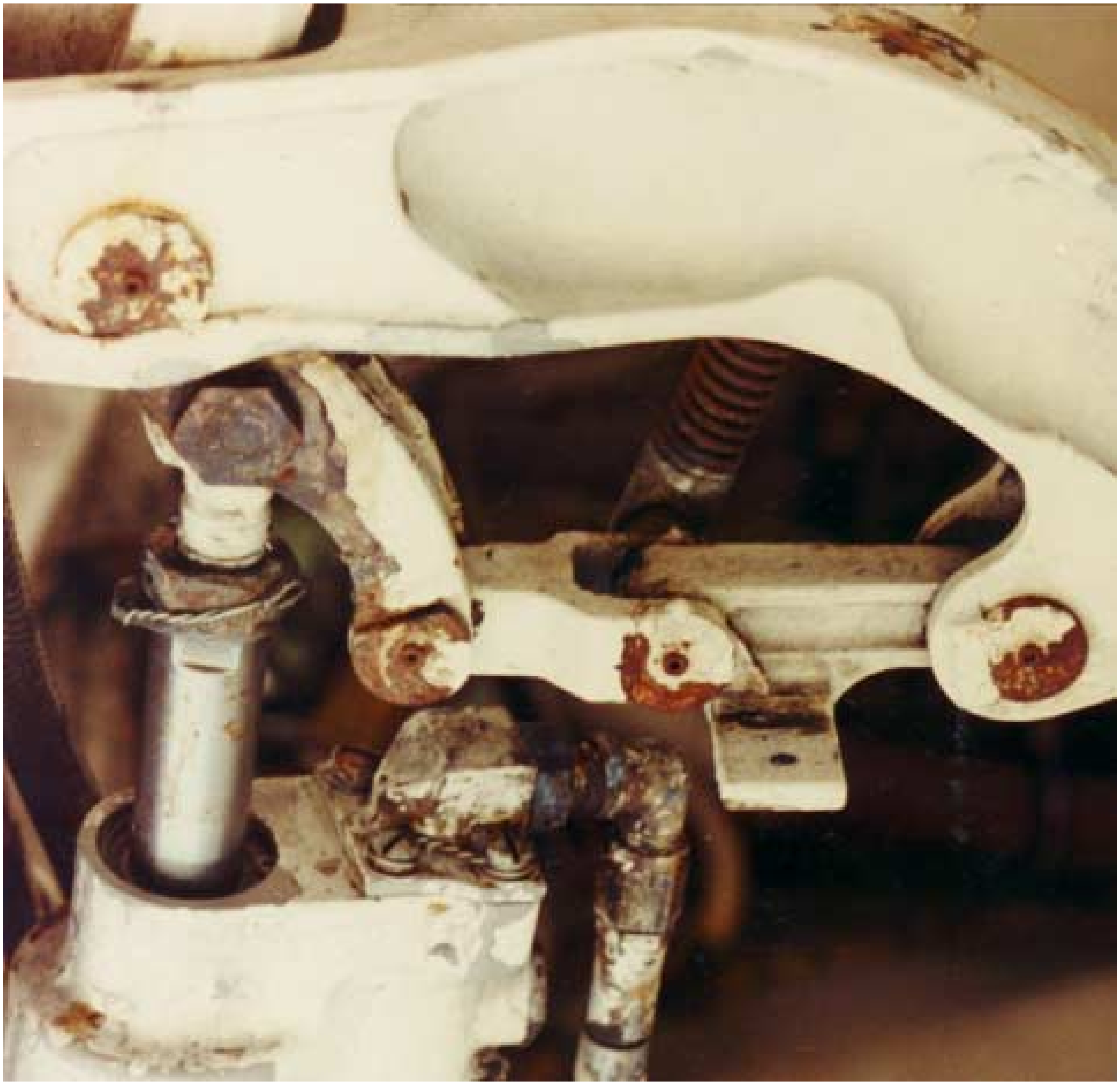


Figure 2–19. Steel Corrosion Products

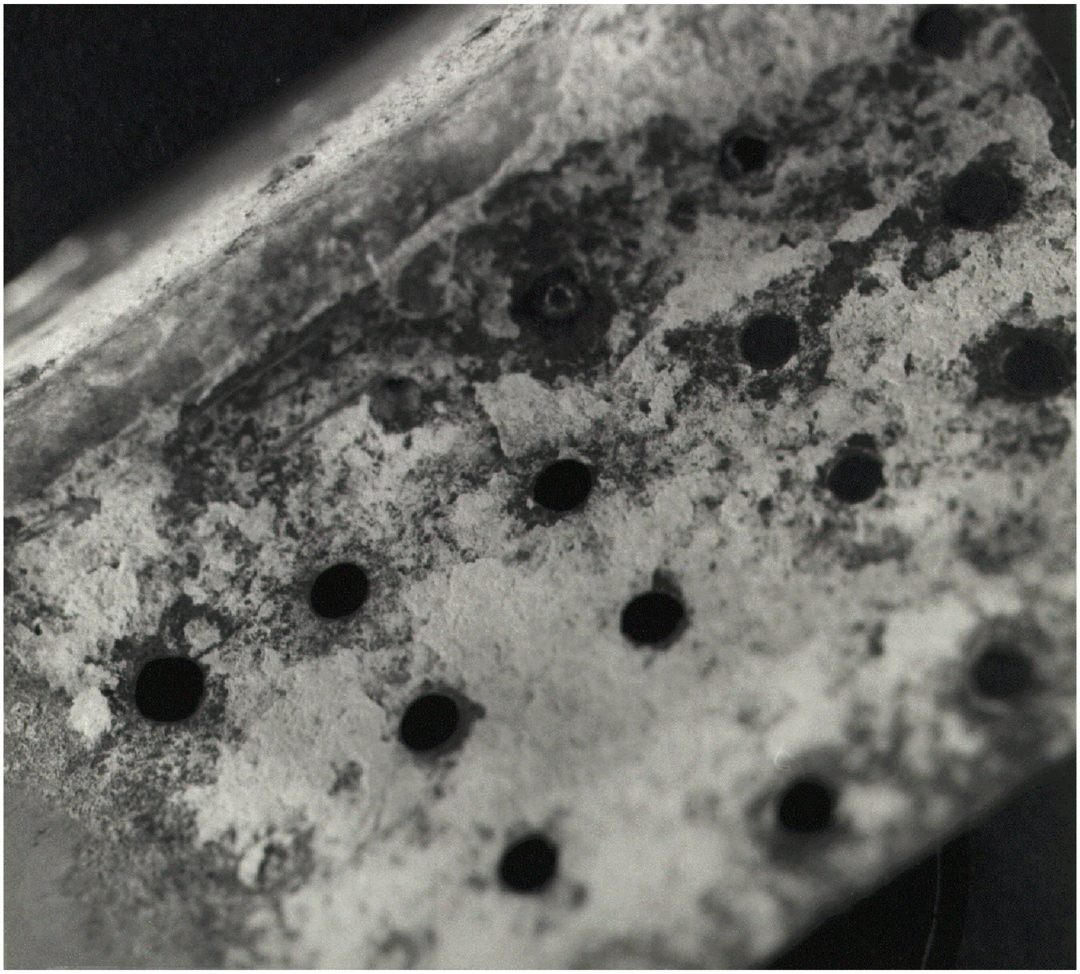


Figure 2-20. Aluminum Surface Corrosion Products

2-9.7. Solar radiation. The two ranges of solar radiation most damaging to materials are ultraviolet, the range that causes sunburn, and infrared, the range that makes sunlight feel warm. On earth, maximum solar radiation occurs in the tropics and equatorial regions, but considerable damage occurs in the temperate zones as a result of solar heating, photochemical effects, and combinations of these two phenomena. Non-metals, especially organic and synthetic materials, are strongly affected by sunlight. Both natural and synthetic rubber deteriorate rapidly under sunlight. After extended exposure, plastics darken, paints lose their protective characteristics, polymers undergo marked decreases in strength and toughness, and colors fade, removing essential color coding. Most electronic equipment is housed in enclosed structures and is protected from solar radiation. Extra care must be taken in the selection and surface treatment of parts, such as cables and harnesses, that are to be exposed to exterior environments.

2-9.8. Climate. Warm, moist air, normally found in tropical climates tends to accelerate corrosion while cold, dry air normally found in arctic climates tends to reduce corrosion rates. Corrosion does not occur in very dry conditions. For this reason, desiccants are used in shipping containers to produce very dry local environments. The operational climate extremes have always been considered in aircraft design. However, certain areas within an aircraft, such as the cockpit and air conditioned equipment bays, may be subjected to climatic conditions very different from external areas of the aircraft. Relatively warm,

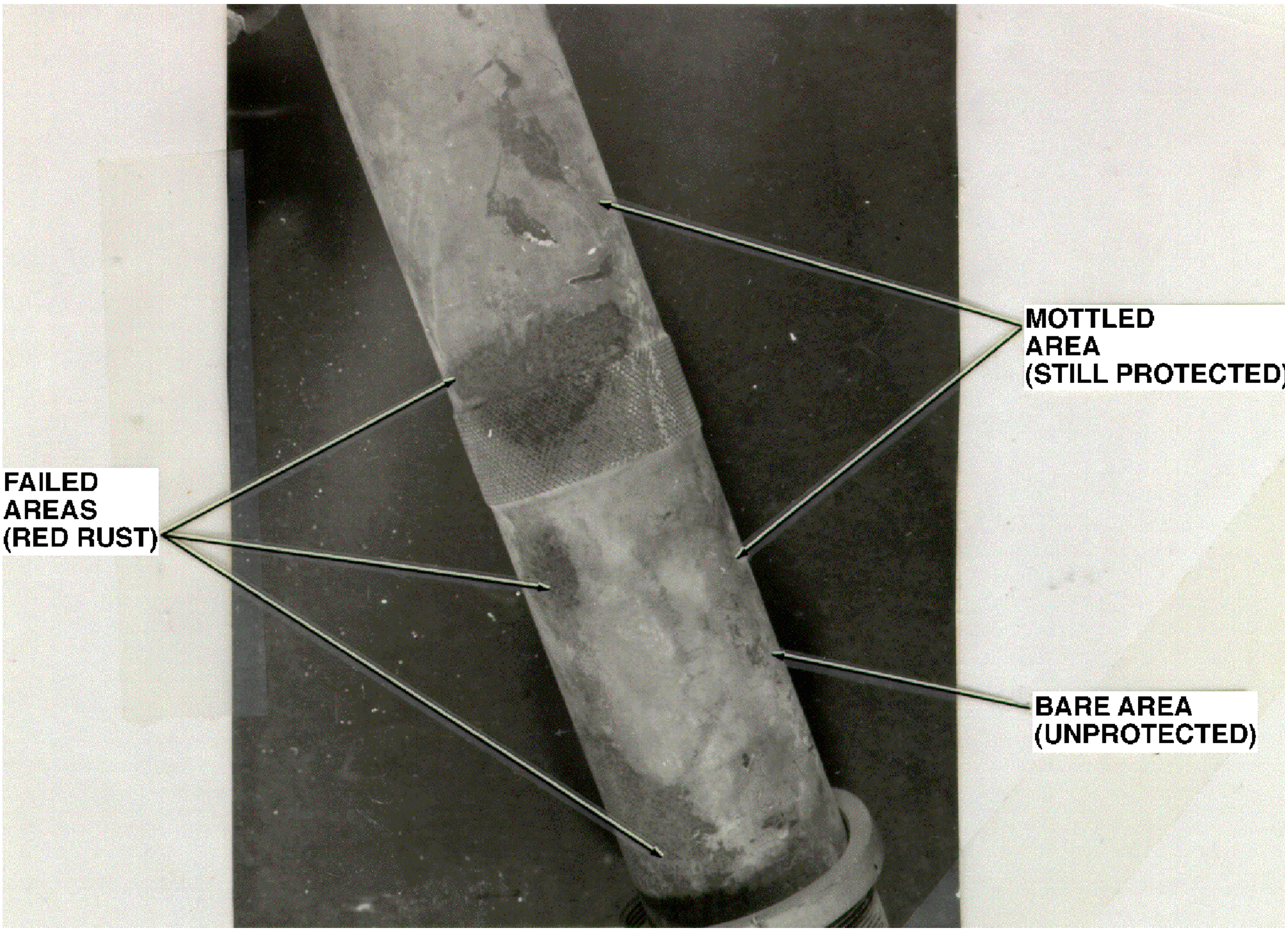


Figure 2-21. Cadmium Plated Surface Conditions

dry air that has been cooled by air conditioners, thus reducing its ability to hold moisture, and ducted into interior areas of the aircraft, can release sufficient moisture to accelerate corrosion. It is imperative, therefore, to consider not only the operational environment but also the environments in which the equipment will be fabricated, transported, reworked, or repaired.

2-9.8.1. Desert. The hot, wind-swept desert creates a severe maintenance problem because powdery dust can penetrate even supposedly sealed components. High daytime temperatures, high humidities (in areas such as the Persian Gulf) ultraviolet radiation, and fine dust are the four most serious, destructive elements of the desert climate. Nonmetallic materials suffer the most damage from the hot desert climates where air temperature during the day may reach 124_F (50_C). Temperatures inside closed containers may be 100_F (38_C) higher than external air temperatures.

2-9.8.2. Temperate zones. The temperate or intermediate climate zone encompasses most of the North American and European continents. These areas at various times of the year may approximate the extremes of polar, desert, or tropical temperatures and humidity. The temperate zone temperatures range from -25_ to 59_F (-32_ to 15_C) in the winter and from 59_ to 125_F (15_ to 52_C) in summer. The relative humidity also fluctuates between five

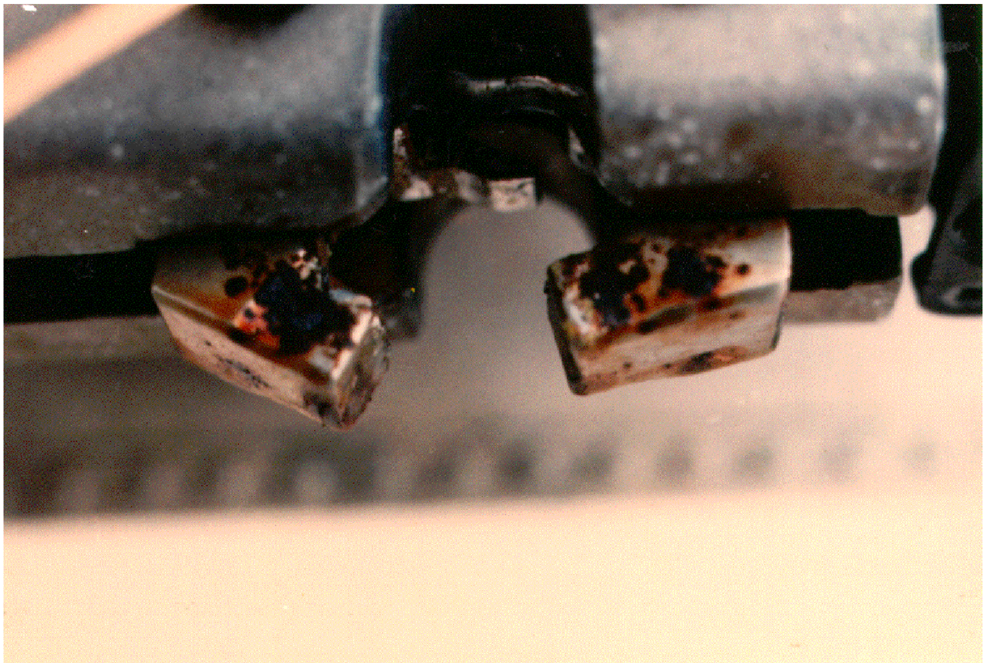


Figure 2-22. Failed Chromium Plate

and 100%. The most critical areas are coastal locations, during the warm periods of the year in which the relative humidity approaches 100% at night and the air has high concentrations of salt. Moisture from this salt-laden air can condense on equipment during early evening and morning hours, thereby causing serious corrosion. Because of its relatively mild temperatures, the temperate zone is also the most heavily populated. Consequently, the smoke, smog, ozone, and corrosive fumes associated with heavy industry are also found there.

2-9.8.3. Tropics. The greatest challenge to the aircraft industry is the design of equipment that is protected from corrosion and deterioration in the heat and humidity that prevails in the tropics. Even though they encompass only a small portion of the earth's land area, the tropics demand the greatest amount of consideration from the stand point of corrosion treatment and control. Relative humidities of up to 100% at ambient air temperatures of 85_F (29_C) and dewpoints approaching 85_F (29_C) pose formidable threats of corrosion. When high humidity and temperature conditions are combined with salt-laden air, the corrosive environment becomes extremely severe. The critical combination of high temperatures, condensation, high relative humidity, and contaminants such as salt and sand may cause catastrophic failure of equipment. Deterioration of the materials used in electronic equipment may also be accelerated.

2-9.8.3.1. Factors of influence in tropical environments. Microorganisms multiply excessively in tropical environments attacking many non-metallic materials. The tropical environment is sustained by long periods of heavy rainfall, during which as many as 100 inches of rain may fall. Extended periods of high heat and humidity contribute to rapid corrosion of metals, cracking and flaking of rubber and plastic materials, and deterioration of seals. Equipment, whether stored or in use, requires special protective containers and frequent preventive maintenance. Many items become covered with fungi in a matter of hours. For effective operation of electronic equipment in the tropics, special efforts must be made. Intensive preventive maintenance and the best possible protective techniques are necessary for aircraft and their components.

2-9.9. Manufacturing. During the manufacture, assembly, or repair of aircraft and their subsystems, many factors that might lead to corrosion may be introduced. The use of unsuitable materials and improper materials processing can cause corrosion. The shearing or hole–punching operations on some metal alloys, especially high–strength aluminum, may introduce stresses that eventually lead to corrosion. Assembly of parts in areas contaminated by fumes or vapors from adjacent operations may result in entrapment of the fumes in the equipment that may cause future corrosion. Spaces that are conditioned without humidity control may be sources of condensed moisture.

2–9.10. Storage. Even traces of corrosive vapor in packages containing aircraft parts may result in serious corrosion. Moreover, the natural breathing of packages may introduce moisture into the parts and equipment. Some packing materials have been known to decompose and emit corrosive vapors during periods of prolonged storage. Refer to NAVAIR 15–01–500 (Navy), TM 743–200–1 (Army), or T.O. 1–1–17 (Air Force) for additional storage information.

2–9.11. Shipment. During shipment, materials such as plastics and lubricants are often exposed to environments that were not considered during the design stage. Materials shipped by air are subjected to changes in atmospheric pressure and can lose volatile components by outgassing. The vibration and mechanical shocks associated with shipment by truck can damage protective coatings or platings. Shipment by ocean vessel may expose the equipment to corrosive marine environments, vibrations and shock from engines or sea conditions, and residual corrosive vapors from previous shipments. Although packaging the equipment in accordance with MIL–P–116 will protect the equipment from corrosive environments, packaging may be damaged during handling and thus become ineffective.

2–9.12. Industrial and ship emitted air pollutants. Smog, smoke, soot, and other airborne contaminants are extremely corrosive to exposed aircraft and equipment. Many of the fumes and vapors emitted by ships and from factories can greatly accelerate metal corrosion. Industrial atmospheres may exist over large areas, since wind may carry these corrodents many miles from their source. Generally, air pollutants, when combined with water, will become electrolytic solutions and accelerate corrosion.

2–9.13. Animal damage. Damage to aircraft and aircraft subsystems may be caused by insects, birds, and various small animals, especially in tropical environments. Equipment in storage is most susceptible to this type of attack, since animals may enter through vent holes or tears in packaging and sometimes build nests. Moisture absorbed by nests plus excretions from animals may cause corrosion and deterioration that goes unnoticed until equipment is put to use and fails. Another type of damage may occur when organic materials, such as upholstery, are shredded for nests or consumed as food.

2–9.14. Microorganisms. Microbial attack, as the term is used in this manual, includes the action of bacteria, fungi, or molds. Microorganisms are nearly everywhere and outnumber all other types of living organisms. Those organisms causing the greatest corrosion problems are bacteria and fungi. Damage resulting from microbial growth can result from: (1) the tendency of the growth to hold moisture which then causes corrosion; (2) digestion of the substrate as food for the microorganism; or (3) corrosion of the surface beneath the growth by secreted corrosive fluids.

2–9.14.1. Bacteria. Bacteria may be either aerobic or anaerobic. Aerobic bacteria require oxygen to live. They can accelerate corrosion by oxidizing sulfur to produce sulfuric acid or by oxidizing ammonia to produce nitric acid. Bacteria living adjacent to metals may promote corrosion by depleting the oxygen supply or by releasing metabolic products. Anaerobic bacteria, on the other hand, can survive only when free oxygen is not present. The metabolism of these bacteria requires them to obtain food sources by oxidizing inorganic compounds such as iron, sulfur, hydrogen, and carbon monoxide. The resultant chemical reactions cause corrosion.

2–9.14.2. Microbial growth requirements. Fungi make up one class of microorganisms that feeds on organic matter. Low humidity levels will inhibit the growth of most species of fungi and bacteria. Ideal growth conditions for most fungi and bacteria are temperatures between 68_ and 104_F (20_ and 40_C) and relative humidities between 85 and 100%. It was formerly believed that microbial attack could be prevented by applying moisture–proof coatings to nutrient materials or by drying the interiors of compartments with desiccants. However, some moisture–proof coatings are attacked by microorganisms, especially if the surface on which they are used is contaminated. Some microorganisms can survive in spore form for long periods while dry, and can become active when moisture is available. When desiccants become saturated and unable to absorb moisture passing into the affected area, micro–

organisms can begin to grow. Dirt, dust, and other airborne contaminants are the least recognized contributors to microbial attack. Unnoticed, small amounts of airborne debris may be sufficient to promote fungal growth.

2–9.14.3. Microbial nutrients. Since fungi, bacteria, and other microorganisms are classified as living, it was previously thought that only materials derived from living organisms could provide food for microorganisms. Thus, wool, cotton, feathers, leather, etc., were known to be microbial nutrients. To a large extent this rule of thumb is still valid, but the increasing complexity of synthetic materials makes it difficult, if not impossible, to determine from the name alone whether a material will support growth of microorganisms. Many otherwise resistant synthetic materials are rendered susceptible to microbial attack by the addition of chemicals, which change the properties of the material. In addition, different species of microorganisms have different growth requirements. The service life, size, shape, surface smoothness, cleanliness, environment, and species of microorganism involved all determine the degree of microbial attack on the affected item.

2–10. DEGRADATION OF NON–METALS. Non–metallic materials (plastics, elastomers, paints and adhesives) are not subject to electrochemical corrosion, since ions are not easily formed from non–metallic materials and since the electrical conductivity of non–metals is extremely low. The degradation of non–metals depends on the chemical makeup of the material and the nature of the environment. In general, aircraft non–metallic materials are selected for their obvious performance properties (flexibility, transparency, strength, electrical resistance, etc.) as well as their resistance to heat, impact, abrasion, ultraviolet radiation, moisture, ozone and other detrimental gases as well as operational fluids such as hydraulic fluid, lube oil, cleaners, deicing fluids and others. However, the use of unauthorized maintenance chemicals and procedures can accelerate degradation and ultimately lead to material failure resulting in leakage, corrosion, electrical shorts, crazing, and/or mechanical failure.

2–11. PREVENTIVE MAINTENANCE. The two most important factors in preventing corrosion, and the only ones which can be controlled by field personnel, are the removal of the electrolyte and the application of protective coatings. Since the extent of corrosion depends on the length of time electrolytes are in contact with metals, corrosion can be minimized by frequent washing. If non–corrosive cleaners are used, the more frequently a surface is cleaned in a corrosive environment the less the possibility of corrosive attack. In addition, by maintaining chemical treatments and paint finishes in good condition, corrosion can be minimized. The degradation of non–metallic materials can be minimized by avoiding the use of unauthorized maintenance chemicals and procedures. In addition, when repair or replacement of non–metallic materials is required use only approved materials. Dedication to proper preventive maintenance practices maximizes equipment reliability.

CHAPTER 3

PREVENTIVE MAINTENANCE

3–1. PREVENTIVE MAINTENANCE PROGRAM. The prevention and control of corrosion on aircraft and related equipment is a command responsibility. Each command must place special emphasis on the importance of the corrosion control program and lend its full support to ensure that corrosion prevention and control receives sufficient priority to be accomplished along with other required maintenance.

3–1.1. Preventive maintenance. Aluminum and magnesium alloys found in aviation equipment will normally begin to corrode if salt deposits, other corrosive soils, or electrolytes are allowed to remain. In order to prevent corrosion, a constant cycle of cleaning, inspection, operational preservation, and lubrication must be followed. Prompt detection and removal of corrosion will limit the extent of damage to aircraft components. An effective preventive maintenance program requires cleaning, lubrication and preservation, as well as corrosion removal, paint removal, surface treatment, sealing, and painting. A disciplined preventive maintenance program includes:

a. Regularly scheduled aircraft washing as specified by parent service organization directives;

b. Regularly scheduled cleaning or wipe down of all exposed unpainted surfaces, such as landing gear struts and actuating rods of hydraulic cylinders as specified by parent service organization directives, with a compatible fluid or lubricant;

c. Keeping low–point drains open;

d. Inspection, removal, and reapplication of corrosion preventative compounds (CPCs) on a scheduled basis;

e. Earliest detection and repair of damaged protective coatings;

f. Using clean water with low chloride content for aircraft washing and rinsing (chloride content should be less than 400 parts per million, approximately the same limit as that for potable water); and

g. Using padded panel racks to store panels/parts for aircraft and equipment during maintenance and using protective measures to prevent abrasions/scratches resulting from placement of parts, tools, tool boxes, etc. on wings, fuselage or other aircraft surfaces.

CHAPTER 3

PREVENTIVE MAINTENANCE

SECTION I. CLEANING

3–2. INTRODUCTION.

CAUTION

Authorized cleaning agents are listed in this chapter and Appendix A. Do not use unauthorized cleaners. Although commercial cleaners may perform as well or better than approved products, these materials may be corrosive to aircraft alloys.

NOTE

Ozone depleting substances (ODS) are solvents such as, but not limited to, 1,1,1 Trichloroethane (MIL–T–81533) and Trichlorotrifluoroethane (MIL–C–81302). These solvents, as well as products containing them, are still used in some aircraft maintenance processes, including high pressure oxygen systems cleaning and some avionics cleaning. Alternate materials continue to be identified. Wherever possible, specifications are being changed to eliminate their use automatically. Some products that have been reformulated are now flammable. Pay close attention to all CAUTION/WARNING labels on solvents and solvent–based products.

3–2.1. Reasons for cleaning. Aircraft cleaning is the first step in preventing aircraft corrosion. Cleaning requires a knowledge of the materials and methods needed to remove corrosive contaminants and fluids which tend to retain contaminants. Aircraft should be cleaned regularly in order to:

a. Prevent corrosion by removing salt deposits, other corrosive soils, and electrolytes;

b. Maintain visibility through canopies and windows;

c. Allow a thorough inspection for corrosion and corrosion damage;

d. Maintain turbine engine efficiency;

e. Reduce fire hazards by the removal of accumulations of leaking fluids;

f. Improve overall appearance;

g. Ensure aerodynamic efficiency of the aircraft; and

h. Maintain special paint scheme characteristics.

3–2.2. Frequency of cleaning. All aircraft shall be cleaned according to schedules required by the parent service organization. Navy and Marine Corps aircraft shall be cleaned at least every 7 days when aboard ship and at least every 14 days when ashore. See Appendices D and E for Army and Air Force requirements. Under certain local conditions, depending on the type of aircraft and usage, the normal wash cycle may not be sufficient. More frequent cleaning may be required for certain types of aircraft when:

a. Excessive exhaust or gun blast soil and exhaust gases accumulate within impingement areas;

b. Paint is peeling, flaking, or softening;

c. Fluid leakage (coolant, hydraulic fluid, oil, etc.) occurs; or

d. Exposure to salt spray, salt water, or other corrosive materials occurs.

3–2.3. Daily cleaning. When deployed within 3 miles of salt water or when flown below 3000 feet over salt water, daily cleaning or wipe down is required on all exposed, unpainted surfaces, such as landing gear struts and actuating rods of hydraulic cylinders.

NOTE

Optimum use of taxi–through rinse facilities is recommended for removal of salt contamination and light deposits when operating near sea water. Rinsing does not satisfy aircraft washing requirements, it only removes readily soluble matter from exterior surfaces.

3–2.4. Immediate cleaning. Affected areas must be cleaned immediately if:

a. Spilled electrolyte and corrosive deposits are found around battery terminals and battery area;

b. Aircraft are exposed to corrosive fire extinguishing materials;

c. Salt deposits, relief tube waste, or other contaminants are apparent;

d. Aircraft are exposed to significant amounts of salt water;

e. Fungus growth is apparent; or

f. Chemical, biological, or radiological (CBR) contaminants are detected.

3–2.4.1. Procedures for decontamination of aircraft exposed to chemical, biological or radiological (CBR) materials are contained in FM 3–5 (Army), T.O. 00–110A–1 (Air Force), or A1–NBCDR–OPM–000 (Navy).

3–3. CLEANING COMPOUNDS. Cleaning compounds work by dissolving soluble soils, emulsifying oily soils, and suspending solid soils. There are several types of cleaning compounds, each of which cleans a surface using one or more of these mechanisms.

CAUTION

Hydrogen embrittlement. When high strength steels (typically 180 ksi and above), some high strength aluminum, and some stainless steels are exposed to acid paint removers, plating solutions, and other acidic conditions (cleaners, etc.) and some alkaline materials, a cathodic reaction on the metal surface produces hydrogen. The hydrogen diffuses into the bulk metal, accumulating at grain boundaries and weakening the structure. If the part is under load or contains residual manufacturing stresses, sudden catastrophic failure occurs when the part can no longer sustain the internal and/or applied stresses. Hydrogen embrittlement has been known to occur in parts stressed to only 15 percent of nominal tensile strength.

3–3.1. Alkaline cleaners. Highly alkaline cleaning compounds (pH greater than 10) are not authorized for Navy or Army aircraft, due to incompatibility with polyimide airframe wiring insulation. Moderately alkaline cleaners (pH between 7.5 and 10), such as MIL–PRF–85570, Types I and II (Exterior Aircraft Cleaning Compound), are recommended. Both types contain detergents and foaming agents, and work in the same way as a detergent solution. Type I is a more effective cleaner for heavy oils and greases, including wire rope lubricant, due to its solvent content, but it should not be used in areas where ventilation is poor. Type II contains no solvent but is an excellent cleaner for light oils and hydraulic fluids, and can be used in areas of reduced ventilation (such as cockpits, cabins, bilges, and equipment bays).

NOTE

Air Force organizations shall use engine T.O. procedures for cleaning aircraft engine interiors.

3–3.2. Aqueous and solvent emulsion turbine gas path cleaners. Due to its solvent content, MIL–PRF–85704, Type I (Cleaning Compound, Turbine Engine Gas Path, (solvent emulsion concentrate)) becomes an emulsion when diluted. The solvent contained in the MIL–PRF–85704, Type I cleaner softens oily soils so that they can be emulsified by the detergent and rinsed away with clean fresh water. MIL–C–85704, Types II and II RTU (aqueous cleaner without hydrocarbon) have also been approved for use. Type II is supplied as “concentrated” and Type II RTU is “ready–to–use”. MIL–PRF–85704 is specially formulated to minimize aircraft turbine engine corrosion during wash cycles; no other cleaner shall be used for this purpose. Since Type I, like most solvent emulsion cleaners, can leave a very thin oil or solvent film, another type of cleaner shall be used prior to pretreating, painting, sealing or bonding. Local air pollution regulations may restrict the amount and methods of application of the Type I solvent emulsion cleaner; therefore, Types II or II RTU shall be considered.

3-3.3. Detergent solution. MIL-D-16791 (Detergents, General Purpose Liquid Nonionic) dissolved in water cleans by dissolving soluble salts, emulsifying low viscosity oils, and suspending easily removed dirt and dust. It is not very effective on grease, but is an excellent cleaner for interior lightly soiled areas, plastics, and instrument glass covers.

3-3.4. Special cleaners. In addition to the above general cleaners, three cleaners (to be used without dilution), are approved for specific localized applications in areas of heavy soil.

NOTE

Solvents in MIL-PRF-85570 Type IV cleaner may be hazardous air pollutants (HAPs). Consult local regulations before use. MIL-PRF-85570 Type V may be used as an alternate.

3-3.4.1. Low gloss tactical paint scheme spot cleaner. MIL-PRF-85570, Type IV is recommended for cleaning exhaust track and gun blast deposits, smudges, boot marks, and other embedded soils on low gloss coatings. This material contains solvents, detergents, and suspended rubber particles. When rubbed on a soiled surface, the rubber particles act like tiny erasers, removing soil by mechanically entrapping it in the rubber. The gloss of camouflage coatings is unchanged. For more information on camouflage paint schemes see Chapter 7.

3-3.4.2. Thixotropic (viscous) cleaner. MIL-PRF-85570, Type V is recommended for cleaning wheel wells and wing butts, and replaces solvent cleaning where water rinsing can be tolerated. This cleaner contains solvents, detergents and some thickening agents. When applied undiluted to an oily or greasy surface, the cleaner clings long enough to emulsify the soil (about 5 to 15 minutes) and can then be rinsed away with fresh water. To perform most effectively, Type V must be applied to a dry surface. Do not prerinse areas of the aircraft that require application of Type V. MIL-PRF-85570 Type V may also be used as an alternate for MIL-C-43616. Apply to the area, allow to dissolve for approximately 1 - 2 minutes, scrub with brush and rinse thoroughly.

3-3.4.3. Parts washer cleaning solution. MIL-C-29602 (cleaning compounds for parts washer and spray cabinets), diluted with water in accordance with manufacturer's recommended concentrations, is the cleaning agent to be used in high pressure cabinet style parts washers for removing oils and greases from disassembled components. It is not to be used for bearings unless authorized by part specific documentation. Also, due to the maximum allowable pH (pH 13.5) that AMS-C-29602 cleaning compound can attain, aircraft cognizant engineering authority approval is required before cleaning aluminum alloy parts.

3-3.5. Solvents. Cleaning solvents dissolve oily and greasy soils so that they can be easily wiped away or absorbed on a cloth. However, solvents differ significantly in cleaning ability, toxicity, evaporation rate, effect on paint, and flammability. MIL-PRF-680, Type II is the most common cleaning solvent used on aircraft, due to its low toxicity, minimal effect on paint, and relative safety. Other solvents, such as alcohols, ketones, chlorinated solvents, and naphtha, are specialized materials restricted for use, as recommended in Table 3-1.

NOTE

The use of solvents for cleaning operations is becoming more and more limited due to environmental regulations. Determine local requirements regarding limitations on volume used and disposal from your work center supervisor, safety officer, or industrial hygienst.

NOTE

Degreasing Solvent, MIL-PRF-680, replaces Dry Cleaning and Degreasing Solvent, P-D-680. MIL-PRF-680 has been reformulated to reduce Hazardous Air Pollutants by reducing the aromatic content of the solvent.

3-3.5.1. Degreasing Solvent (MIL-PRF-680). This solvent is used as a cleaner and degreaser for painted and unpainted metal parts. It is also used to remove corrosion preventive compounds. The solvent is available in four types. Although the degreasing effectivness is approximately the same, the flash points differ as follows: Type I, 100_F (38_C) minimum; Type II, 140_F (61_C) minimum; Type III, 200_F (93_C) minimum; Type IV, 140_F (61_C) minimum. Though the flash points differ, all types will burn intensely once ignited. Type I is not authorized for use as a general cleaner due to its flammability, but may be used in parts washers designed for such solvents. Type II is the most common cleaning solvent used on aircraft, and is intended for use where a solvent with a higher flash point is required. If necessary, Mineral Spirits, ASTM D235, Type II, Class C, may be used as a substitute for MIL-PRF-680, Type II. Type III is intended for use in confined atmospheric conditions where a very high flash point is required. Type IV is used where a higher flash point and strong solvency is desired. The dwell time for all types should be held to a minimum (less than 15 minutes) to avoid damage to paint.

3-3.5.2. Isopropyl alcohol (TT-I-735). This flammable solvent is a disinfectant for cleaning fungus and mold. It is a poor degreaser.

3-3.5.3. Methyl Ethyl Ketone (MEK) (ASTM D 740). This highly flammable solvent is used for cleaning prior to painting and bonding. It may also be used for cleaning if surfaces become contaminated with leaking fluid after surface treatment. Some locations cannot use MEK due to restrictions on the use of solvents with vapor pressures greater than 44 millimeters of mercury (mm Hg). As an alternate, use MIL-PRF-85570 Type II (diluted 1 part cleaner to 9 parts water), rinse thoroughly with fresh water and allow to dry. Or, surfaces may be cleaned by solvent wiping with AMS 3166 (Solvents, Cleaning, Cleaning Prior to Application of Sealing Compounds).

3-3.5.4. Aliphatic naphtha (TT-N-95). This highly flammable solvent is used for cleaning oily or greasy deposits from acrylic canopy materials. Other solvents cause crazing of acrylics. It can also be used to remove masking or preservation tape residue.

3-3.5.5. Thinner, aliphatic polyurethane coatings (MlL-T-81772). This highly flammable solvent can be used for prepaint solvent cleaning when necessary. MIL-T-81772 can be used at locations requiring a solvent vapor pressure less than 45 mm Hg.

3-3.6. Miscellaneous cleaning agents. Plastic polish (P-P-560) contains mild abrasive matter to polish out scratches in canopy materials. Alkaline chemicals neutralize specific acidic soils: ammonium hydroxide (O-A-451) for urine, sodium bicarbonate (ASTM D928) for electrolyte spills from sulfuric acid batteries, and monobasic sodium phosphate (ANSI/AWWA B504) and boric acid (A-A-59282) for electrolyte spills from nickel-cadmium batteries. Fire extinguishing agent (MIL-F-24385), which contains wetting and foaming agents, washes out residues from fire extinguishing solutions made with salt water. Optical glass cleaner (A-A-59199) is used for cleaning lenses.

3-3.7. Steam cleaning. Steam cleaning shall not be used on aircraft/missiles at the Organizational/Unit or Intermediate levels of maintenance. In addition, steam cleaning shall not be used on the following items removed from aircraft/missiles: honeycomb bonded structure, sealant, fiberglass composites, acrylic windows, or electrical wiring. Steam cleaning erodes paint, crazes plastic, debonds adhesives, damages electrical insulation, and drives lubricants out of bearings.

3-3.8. Dilution. In general, more concentrated solutions than those recommended do not clean any better and are wasteful; MORE IS NOT ALWAYS BETTER. In fact, if too much cleaner is used, the solution merely becomes slippery, preventing the washing pad from loosening the soil and making rinsing more difficult. Do not exceed the use dilutions recommended in Table 3-1.

Table 3–1. Cleaning of Specific Areas and Components

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures

NOTE

Cleaning procedures are listed in this table. Ordering information for approved materials can be found in Appendix A. Ordering information for approved equipment can be found in Appendix B.

NOTE

For supplementary Air Force cleaning requirements, refer to Appendix E. The appendix also includes aircraft wash intervals and additional specific cleaning requirements.

WARNING

Degreasing Solvent (MIL–PRF–680) is combustible. Keep away from open flames. Use in a well–ventilated area. Wear rubber gloves and chemical or splash proof goggles. Avoid skin contact. Consult the local safety office regarding respiratory protection.

Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compound MIL–PRF–85570. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water.

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
EXTERIOR SURFACES, PAINTED	Light soils (dirt, dust, mud, salt, loose soot)	MIL–PRF–85570 Type II or MIL–PRF–85570 Type I	1 part cleaner in 9 parts water 1 part cleaner in 16 parts water	Apply cleaner solution with foam generator, spray, sponge, soft brush, or cloth. Scrub and then rinse with fresh water and dry.
	Moderate soils (hydraulic fluids, lube oils, light preserva–tives)	MIL–PRF–85570 Type II or MIL–PRF–85570 Type I	1 part cleaner in 4 parts water 1 part cleaner in 9 parts water	Apply cleaner solution with foam generator, spray, sponge, soft brush or cloth. Rub gently with a circular motion for up to one minute. Rinse with fresh water and dry.

Table 3–1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
EXTERIOR SURFACES, PAINTED (Cont.)	Heavy soils (carbonized oil, aged preservatives, grease, gun blast and exhaust deposits)	MIL–PRF–85570 Type V	Undiluted	Spray or brush on cleaner. After 5 to 10 minutes, brush and rinse thoroughly.
		or		
		MIL–PRF–680 Type II or III	Degreasing Solvent	Preclean by wiping or solvent brushing soiled area with MIL–PRF–680. Then apply cleaner solution with foam generator, spray, sponge or cloth. Allow the cleaner to dwell for up to one minute without scrubbing then scrub for up to a minute. Rinse thoroughly, then dry. Do not allow cleaning solutions to dry on surfaces, or streaking will occur.
		and		
		A–A–1491	Cotton Cheesecloth	
		and		
		MIL–PRF–85570 Type I	1 part cleaner in 4 parts water	
		or		
		MIL–PRF–85570 Type II	1 part cleaner in 1 part water	
	Stubborn soil on gloss painted aircraft (scuff marks, exhaust, etc.)	MIL–PRF–85570 Type IV or V	Undiluted	Apply cleaner with a damp cloth. Rub with a circular motion. Rinse thoroughly, then dry. Do not allow the cleaner to dry on surfaces or rinsing may be difficult.
	Stubborn soil on Tactical Paint Scheme aircraft (scuff marks, exhaust, etc.)	MIL–PRF–85570 Type IV	Undiluted	Apply cleaner with a non–abrasive cleaning pad. Allow 1–3 minutes dwell time. Rub with a circular motion. Rinse thoroughly, then dry. Do not allow the cleaner to dry on surfaces or rinsing may be difficult.

EXTERIOR SURFACES, UNPAINTED

WARNING

Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compounds MIL–PRF–85570. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water.

CAUTION

Do not allow MIL–PRF–85570, Type I cleaning solutions to contact canopy plastic panels.

Table 3–1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
EXTERIOR SURFACES, UNPAINTED (Cont.)	Gunblast residues, carbonized exhaust	MIL–PRF–85570 Type I or MIL–C–81309 Type II	1 part cleaner in 4 parts water Corrosion Preventive Compound	Wet surface with fresh water. Apply cleaning solution and scrub briskly with abrasive mat (MIL–A–9962, Type 1, Grade A or B). Rinse with fresh water and dry. **NOTE** For stubborn deposits, spray area with MIL–C–81309, Type II, then scrub with flap brush.
INTERIOR AREAS	**WARNING** Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compound MIL–PRF–85570. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water. When using Ammonium Hydroxide, do not breathe vapors and avoid skin contact. Wash immediately if spilled on skin. **CAUTION** When using Ammonium Hydroxide, do not allow any solutions to contact aircraft wiring. Flush immediately with fresh water if spillage occurs Avoid use of compressed air to clean electronic equipment. Do not use abrasives in radome compartment.			
Lavatories	Urine residue	O–A–451 ASTM D928	Ammonium Hydroxide, 1 part in 20 parts water Sodium Bicarbonate, 6 oz. to 1 gallon of fresh water	Sponge with a solution of ammonium hydroxide. Flush with fresh water or wet surface with sodium bicarbonate solution, allow to dry, rinse with fresh water. Dry with a clean cloth.
		USDA Reg 100–12–1	Germicidal Tablets	Use germicidal tablets as toilet and urinal deodorants.

Table 3–1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
INTERIOR AREAS (Cont.)				
Floor and Deck	Dirt, debris	MIL–PRF–85570 Type II Preferred) or MIL–PRF–85570 Type I (alternate)	1 part cleaner in 9 parts water 1 part cleaner in 16 parts water	Remove loose dirt with vacuum cleaner. Wipe with cleaning compound, rinse with fresh water.
Radome and Equipment Compartment (interior)	Dust, dirt, oil and debris	MIL–D–16791 A–A–1491	1 oz. detergent in 1 gallon water Cotton Cheesecloth	Remove loose dirt with vacuum cleaner. Wipe fiberglass with a cloth wet with cleaning solution and rinse with cloth wet with fresh water. Dry with a clean cloth.
Cockpit Interior	Dust, dirt, mud, and light debris	MIL–PRF–85570, Type II or MIL–D–16791 A–A–50129	1 part cleaner in 9 parts water 1 oz. detergent in 1 gallon water Cloth, Flannel	Loosen any accumulations of mud on control pedals, floor, or other cockpit equipment with brush and remove with vacuum cleaner. Wipe with cloth wet with cleaning solution and follow with a cloth wet with fresh water. Dry with a clean cloth.
Environmental Control Ducting	Light debris, dust, and grime	MIL–PRF–85570, Type II or MIL–D–16791	1 part cleaner in 9 parts water 1 oz. detergent in 1 gallon water	Refer to applicable maintenance manuals.
ACRYLIC PLASTIC PARTS (EXCEPT CANOPIES)	**NOTE** Refer to specific aircraft manual to determine acrylic plastic parts.			
	Light soil and smudges	MIL–D–16791 A–A–50129	1 oz. detergent in 1 gallon water Cloth, Flannel	Wipe with cloth wet with cleaning solution and follow with a cloth wet with fresh water. Dry with a clean cloth.

Table 3–1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
INTERIOR PLASTIC AND GLASS PANELS		A–A–50129	Cloth, Flannel	Vacuum and then dust with soft, clean, damp cloth. Keep cloth free of grit by rinsing frequently in water and wringing out.
ELASTOMERIC SEALS	Dust, dirt, oil, and grime	MIL–D–16791 A–A–1491	1 oz. detergent in 1 gallon water Cheesecloth, Cotton	Wipe with cloth wet with cleaning solution and rinse with a cloth wet with fresh water. Dry with a clean cloth.
FABRIC PARTS, SOUND-PROOFING AND UPHOLSTERY	**WARNING** Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compounds MIL–PRF–85570 or MIL–D–16791. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed areas with fresh water.			
	Light soil and oil spots	MIL–D–16791 MIL–PRF–85570 Type II	1 part detergent in 16 parts water 1 part cleaner in 4 parts water	Remove loose dirt with vacuum cleaner. Apply soap solution with sponge and scrub briskly. Rinse with clean, dampened cloth or sponge using clean, fresh water. Allow area to dry. Raise nap by brushing.
CANOPY EXTERIOR, PLASTIC AND GLASS PANELS	**WARNING** Do not use synthetic wiping cloths with flammable solvents, such as aliphatic naphtha (TT–N–95). **CAUTION** Refer to specific aircraft manual to determine cleaning procedures for aircraft canopies. In addition, refer to T.O. 1–1A–12 (Air Force), NAVAIR 01–1A–12 (Navy). Remove rings, watches, or other hard objects from hands and wrists before washing transparent plastics. Personnel must also take precautions to prevent buttons, badges, or other hard objects from scratching surfaces. Do not use hard, dirty, or gritty cloths in cleaning and polishing transparent plastics. Wiping with such cloths can mar and scratch plastic surfaces. Do not use any chemical compounds unless specifically authorized for cleaning plastics. Do not rub dry plastic panels with a dry cloth. It may scratch the surface or create electrostatic charge that attracts dust.			

Table 3–1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
CANOPY EXTERIOR, PLASTIC AND GLASS PANELS (Cont.)	Dust, dirt, grime, salt spray, paint overspray	P–P–560 A–A–50129	Plastic Polish Compound Cloth, Flannel	Flush with fresh water to remove loose dirt. Rub gently with bare hands or clean cloth while applying fresh water. Dry with soft, clean cloth. Follow by applying polishing compound with a soft, clean cloth using a circular motion until clean. Polish with another soft, clean cloth.
	Oil, grease	TT–N–95	Aliphatic Naphtha	Apply naphtha with a soft, clean cloth. Blot gently: solvent will evaporate and not leave a film.
		P–P–560 A–A–50129	Plastic Polish Compound Cloth, Flannel	Apply polishing compound. Rub using a circular motion until clean and polish with another soft, clean cloth.
CONTROL CABLES	**WARNING** Open all circuit breakers associated with battery power (refer to applicable maintenance manuals) prior to application of Degreasing Solvent, MIL–PRF–680. Degreasing Solvent, MIL–PRF–680 is combustible. Keep away from open flames. Use in a well–ventilated area. Wear rubber gloves and chemical or splash proof goggles. Avoid skin contact. Consult the local safety office regarding respiratory protection. **CAUTION** Do not use excessive cleaning solvent on control cables. Solvent will remove internal lubricant.			
	Dust, dirt oil, grease	MIL–PRF–680, Type II or III MIL–C–81309, Type II MIL–PRF–16173, Grade 4	Degreasing Solvent Corrosion Preventive Compound Corrosion Preventive Compound	Wipe with clean cloth dampened with solvent. Apply MIL–C–81309 Type II. Recoat cables with MIL–PRF–16173 Grade 4.
LANDING GEAR EXPOSED PISTON SURFACES	**CAUTION** Wipe away from seal areas to preclude collection of soil at seal junction areas. Make sure piston surface is clean and completely lubricated but not dripping. If piston is dry, telescoping action of strut will force gritty particles into cylinder causing leaks and eventual failure. Do not use aerosol dispensed fluid on hydraulic systems.			

Table 3-1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
LANDING GEAR EXPOSED PISTON SURFACES (Cont.)	Sand, dirt, salt deposits, and other foreign particles	MIL-H-83282 A-A-1491	Hydraulic Fluid Cotton Cheesecloth	Clean exposed surfaces with clean cloth dampened with hydraulic fluid. Take care not to scratch the surface. Wipe away from seals.
DOORS LINKAGES, CYLINDER	**WARNING** Open all circuit breakers associated with battery power (refer to applicable maintenance manuals) prior to application of Degreasing Solvent, MIL-PRF-680. Degreasing Solvent, MIL-PRF-680 is combustible. Keep away from open flames. Use in a well-ventilated area. Wear rubber gloves and chemical or splash proof goggles. Avoid skin contact. Consult the local safety office regarding respiratory protection. **CAUTION** Do not use MIL-PRF-16173, Grade 4 or MIL-C-85054 on microswitches or exposed piston rod surfaces.			
	Dust, dirt, oil, grease	MIL-PRF-680 Type II or III MIL-PRF-16173 Grade 4 or MIL-C-85054	Degreasing Solvent Corrosion Preventive Compound Corrosion Preventive Compound	Brush surfaces as necessary with solvent. Cover rod ends and springs with MIL-PRF-16173, Grade 4. Where lubrication is not required, MIL-C-85054 may be applied.
WHEELS AND BRAKES	**WARNING** Dust, corrosion products, and other fine particles generated from beryllium and beryllium-copper alloys are toxic when inhaled or allowed to contact the skin. Severe poisoning can result if beryllium dust is inhaled. Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compound MIL-PRF-85570. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water.			

Table 3-1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
WHEELS AND BRAKES (Cont.)	Oil, dirt sand, and other foreign matter	MIL-PRF-85570, Type I	1 part cleaner in 4 parts water	Clean exposed areas with cleaner solution by brushing. Rinse thoroughly with fresh water. Relubricate as required.
ARRESTING GEAR AND WHEEL WELLS	**WARNING** Open all circuit breakers associated with battery power (refer to applicable maintenance manuals) prior to application of Degreasing Solvent, MIL-PRF-680. Degreasing Solvent, MIL-PRF-680 is combustible. Use in a well-ventilated area. Keep away from open flames. Avoid contact with skin. Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compound MIL-PRF-85570. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water. **CAUTION** Protect tires from contact with degreasing solvent or cleaning solutions.			
	Dirt, grease, hydraulic fluid, etc.	MIL-PRF-85570, Type V or MIL-PRF-680, Type II or III and MIL-PRF-85570, Type I	Undiluted Degreasing Solvent 1 part cleaner in 4 parts water	Apply thixotropic cleaner (Type V) with spray or brush and allow a 5-15 minute dwell. Brush, if necessary, and rinse thoroughly with fresh water. Repeat rinsing with brushing to remove cleaner residues. Alternate procedure: Brush on solvent to loosen stubborn soil. Apply cleaning solution (Type I), then brush and rinse.

Table 3–1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
ELECTRICAL CONNECTORS AND AVIONIC COMPONENTS	**WARNING** Before cleaning electrical and avionic equipment, make sure electrical power is disconnected. Injury or death may otherwise result. **CAUTION** Avoid use of compressed air in electronic compartments because air can force dust into components and cause damage.			
	Dust, dirt, lint, and other loose foreign matter, grease, oil smudges, light tarnish, corrosion, or fungi			Refer to NAVAIR 16–1–540, T.O. 1–1–689 or TM 55–1500–343–23
ORGANIC MATERIALS	**WARNING** Open all circuit breakers associated with battery power (refer to applicable maintenance manuals) prior to application of isopropyl alcohol (TT–I–735). Do not use synthetic wiping cloths with flammable solvents such as isopropyl alcohol (TT–I–735).			
	Fungi (mold)	TT–I–735 A–A–1491	Isopropyl Alcohol Cheesecloth, Cotton	Wipe with clean cheesecloth wet with isopropyl alcohol. To prevent recurring fungus growth, keep area dry and clean. For treatment of fuel system fungus contact appropriate CFA.
OXYGEN LINES (EXTERIOR SURFACES)	Oil, grease	Refer to specific system manuals.		

Table 3–1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
RELIEF TUBES (EXTERIOR)	**WARNING** Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compound MIL–PRF–85570. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water.			
	Human waste (urine)	MIL–PRF–85570 Type II	1 part cleaner in 9 parts water	Wash thoroughly with solution using a soft, bristle brush, then rinse thoroughly with fresh water.
HELICOPTER AND PROPELLER BLADES	**WARNING** Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compound MIL–PRF–85570. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water.			
	CAUTION Do not use strong alkaline cleaners or concentrated abrasive compounds when cleaning rotor tip cap areas. Refer to systems technical manuals/orders for specific cleaning instructions.			
	Grime, oil, grease, exhaust stains	MIL–PRF–85570, Type II	1 part cleaner in 9 parts water	Apply cleaning solution with a cleaning pad or brush. Rinse with fresh water.
		A–A–3100	Cleaning Pad	
HELICOPTER CARGO AND RESCUE HOIST CABLE, AND END FITTINGS	Salt, salt water	MIL–C–81309, Type II	Water Displacing Compound	Flush thoroughly with fresh water. Blow dry with clean, compressed air or thoroughly dry with a cotton cloth. Spray with MIL–C–81309 compound as cable is being rewound. Remove excess with clean dry cloth.
		A–A–50129	Cloth, Flannel	
HELICOPTER CARGO AND RESCUE HOIST DRUM	**WARNING** Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compounds MIL–PRF–85570. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water.			

Table 3–1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
HELICOPTER CARGO AND RESCUE HOIST DRUM (Cont.)	Salt, salt water	MIL–PRF–85570, Type I	1 part cleaner in 9 parts water	Rinse with fresh water. Apply cleaning solution, scrub with a clean cloth or sponge. Rinse with clean water. Blow dry with clean, compressed air or dry with a clean, dry cloth.
HELICOPTER RESCUE SLING	**WARNING** Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compounds MIL–PRF–85570 or MIL–D–16791. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water.			
	Salt, salt water	MIL–PRF–85570, Type II or MIL–D–16791	1 part cleaner in 9 parts water 1 part detergent in 16 parts water	Rinse with fresh water. Apply cleaning solution with sponge or clean cloth. Rinse thoroughly with fresh water. Blow dry with clean compressed air or suspend and allow to dry. If suspended to dry ensure water will drain away from the buckle.
ENGINES, RECIPRO-CATING	**WARNING** Open all circuit breakers associated with battery power (refer to applicable maintenance manuals) prior to application of Degreasing Solvent, MIL–PRF–680. Degreasing Solvent, MIL–PRF–680 is combustible. Keep away from open flames. Use in a well–ventilated area. Wear rubber gloves and chemical or splash proof goggles. Avoid skin contact. Consult the local safety office regarding respiratory protection.			
	Dust, dirt, or oil	MIL–PRF–680, Type II or III A–A–3100	Degreasing Solvent Cleaning Pad	Apply solvent with cleaning pad or brush. Repeat application and dry. Collect solvent runoff and dispose in accordance with local regulations.
GAS TURBINE ENGINE INTERIOR, GAS PATH	**WARNING** Wear rubber gloves, chemical or splash proof goggles, protective wet weather clothing where necessary, and water resistant boots during cleaning operations using cleaning compound MIL–PRF–85704, Types II or II RTU. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed areas with fresh water.			

Table 3–1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
GAS TURBINE ENGINE INTERIOR, GAS PATH (Cont.)	**CAUTION** Use only MIL–PRF–85704 cleaning compound for cleaning turbine engine gas paths. Prepare aircraft in accordance with applicable maintenance manuals or maintenance cards. In case of conflict, maintenance manuals will take precedence over the following instructions.			
	MIL–PRF–85704, Type I gas path cleaners typically contain 30 to 60 percent solvent. When diluted (1 part cleaner to 4 parts water), some products are above the 10 percent limit and most contain enough naphthalene to cause wash rack runoff to exceed the discharge permit limits. The current substitute is MIL–PRF–85704, Type II, a water–base product that contains less than 10 percent solvent in the concentrate. This material shall be used at the same dilution and following the same crank wash procedures, which are currently approved in aircraft engine manuals. MIL–PRF–85704, Type II RTU is ready to use (does not require dilution, but requires 5 times the storage space).			
	Oxidized oil, dust, carbon, salt deposits	MIL–PRF–85704, Type II or	1 part cleaner in 4 parts water	Use in accordance with applicable engine maintenance manual instructions. Dispose of waste cleaner in accordance with local regulations.
		MIL–PRF–85704, Type II RTU	Do not dilute, this is a ready mix form	Navy: Refer to Appendix C for additional information.
GAS TURBINE ENGINE EXTERIOR, ENGINE BAY AND ENGINE BAY DOORS	**WARNING** Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compounds MIL–PRF–85570 or MIL–PRF–85704. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water.			
	CAUTION Prepare aircraft in accordance with applicable maintenance manuals or maintenance cards. In case of conflict, these will take precedence over the following instructions.			

Table 3–1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
GAS TURBINE ENGINE EXTERIOR, ENGINE BAY AND ENGINE BAY DOORS (Cont.)	Oxidized oil, dust, carbon, salt deposits	MIL–PRF–85704, Type I	1 part cleaner in 4 parts water	Apply mixed cleaning solutions (MIL–PRF–85704, Type I or Type II RTU or MIL–PRF–85570, Type II) with a brush, scrub, then rinse with fresh water. When using MIL–PRF–85570, Type V, apply concentrate with a brush, allow cleaner to remain on surface for 5 minutes, then brush and rinse thoroughly. Dispose of waste cleaner in accordance with local regulations.
		or		
		MIL–PRF–85704, Type II RTU	Do not dilute, this is a ready to use form	
		or		
		MIL–PRF–85570, Type II	1 part cleaner in 4 parts water	
		or		
		MIL–PRF–85570, Type V	Use concentrate	
BATTERY COMPARTMENTS	**WARNING** Never use a wire brush to clean a battery. Wear rubber gloves, a rubber apron, and protective goggles when handling batteries. **CAUTION** Nickel–cadmium batteries must not be exposed to acid or acid vapors. Battery electrolytes are extremely corrosive. Spilled electrolyte shall be removed immediately. Refer to applicable aircraft manuals for battery type. Fumes from overheated electrolyte will spread to adjacent areas, causing rapid corrosion on unprotected surfaces. **NOTE** Air Force: Use alternate procedures in chapter 8.			
	Nickel–cadmium battery electrolyte deposits (potassium hydroxide solution)	ANSI/AWWA B504	Monobasic sodium phosphate 6 oz. in 1 gallon water	Remove spilled electrolyte immediately by flushing with fresh water. Neutralize the area by sponging generously with sodium phosphate solution. Brush with a fiber brush, then flush with fresh water. Dry with clean wiping cloths. Keep the cell vents open. Preserve compartment with MIL–C–81309 Type II. Do not paint or preserve batteries.
		MIL–C–81309, Type II	Corrosion Preventive Compound	

Table 3–1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
BATTERY COMPART- MENTS (Cont.)	Lead–acid acid battery electrolyte deposits	ASTM D928 MIL–C–81309 Type II	Sodium bicar- bonate, 6 oz. in 1 gallon water Corrosion Preventive Compound	Remove spilled electrolyte immediately by flushing with fresh water. Neutralize the area by sponging with sodium bi– carbonate solution. Apply generously until bubbling stops. Let it stay on 5 minutes, but do not allow to dry. Brush with a fiber brush, then flush with fresh water. Dry with clean wiping cloths. Keep the cell vents open. Preserve compartment with MIL–C–81309 Type II. Do not paint or preserve batteries.
BILGE AREAS	**WARNING** Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compound MIL–PRF–85570. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water. Degreasing Solvent, MIL–PRF–680 is combustible. Use in a well–ventilated area. Keep away from open flames. Avoid contact with skin.			
	Hydraulic fluid, water, dirt, me- tallic debris	MIL–PRF–85570, Type II or MIL–PRF–85570, Type I or	1 part cleaner in 9 parts water 1 part cleaner 16 parts water	Vacuum clean liquids and debris and dry. Wipe area with a sponge dampened in cleaning solution. Rinse by sponging with fresh water. Wipe dry with a clean cloth.
		MIL–PRF–680, Type II or III	Degreasing Solvent	Wipe with cloth dampened with solvent. Wipe dry with a clean cloth.

Table 3–1. Cleaning of Specific Areas and Components (Cont.)

Area or Component	Type of Soil	Cleaning Agent or Material	Mixing Directions or Nomenclature	Cleaning Procedures
BILGE AREAS (Cont.)	Algae contamination	MIL–PRF–85570, Type II or MIL–PRF–85570, Type I or MIL–PRF–85570, Type V	1 part cleaner in 1 parts water 1 part cleaner in 4 parts water Use concentrate	Mix cleaner and water in a pump spray bottle. Spray mixture on contaminated area and allow to dwell at least 2 minutes. Wipe off with a sponge and dry with a clean cloth.
OPTICAL GLASS	Dust, grease, oil	A–A–59199 A–A–50129	Optical cleaner Cloth, Flannel	Spray cleaner onto flannel cloth and carefully wipe the lens surface. Wipe dry.
EJECTION SEATS	**WARNING** Application of corrosion preventive compounds CPCs or paints to certain areas could prevent or restrict seat operation. Specific ejection seat instructions must be followed carefully. Refer to specific ejection seat maintenance manuals and ACC/SPM instructions for other ejection seats. Navy: see COMNAVAIRPACINST 4750.2D for corrosion control and lubrication of Martin–Baker ejection seats. Air Force: use system specific manuals.			
REMOVABLE METAL FUEL TANKS	Fuel residue, grease, exhaust deposits	MIL–D–81956		Navy: use MIL–D–81956 detergent in accordance with procedures in NAVAIR 01–1A–35. Air Force and Army: use system specific manuals.

3–4. CLEANING EQUIPMENT.

CAUTION

No equipment which develops more than 175 psi nozzle pressure shall be used to apply cleaning compounds unless specifically authorized by the parent service organization.

NOTE

Use only cleaning materials or equipment authorized by the parent service organization and described in this manual. Experimentation with unauthorized cleaners may damage aircraft, reducing reliability and increasing maintenance costs.

Equipment specific to one type of aircraft is not covered in this manual. The following equipment is available for general cleaning. Ordering information for approved equipment can be found in Appendix B. General operating instructions are found in paragraph 3–4.10. See specific operating manuals for detailed instructions on automated equipment.

3–4.1. Portable, 15 gallon, Foam Generating, Cleaning Unit. The cleaning unit is compact, light, and ideal for cleaning hard to reach areas. It consists of 54 inch applicator wand, 50 feet of hose, and a 15 gallon tank which moves easily on rubber tire wheels. (See Figure 3–1). The control system allows the operator to adjust wetness of foam to fit any job. The cleaning unit provides a foam capable of clinging to vertical surfaces to soften and dislodge soils. Operating instructions for the cleaning unit are given in paragraph 3–4.10.1.

3–4.2. Portable, 45 gallon, Foam Generating, Cleaning Unit. This cleaning unit is a simplified, pressure operated, foam–dispensing system. (See Figure 3–2). It uses available air supply for its power source without using pumps. Air is metered directly from the pressurized solution chamber into the hose to create foam. Operating instructions for the cleaning unit are given in paragraph 3–4.10.2.

3–4.3. Turbine Engine Compressor Cleaning Equipment. Equipment used for cleaning Navy aircraft turbine engines is contained in Appendix C. Air Force: refer to specific engine T.O. Army: refer to specific engine technical manual.

3–4.4. Miscellaneous large cleaning equipment. Other equipment such as truck or trailer mounted spray or foam equipment may be available at certain locations.

3–4.5. Spray cleaning gun for solvents. This solvent spray gun has an extended nozzle/tube and requires approximately 14 cfm of air at 50 psi to siphon solvent or cleaner from a container.

3–4.6. Pneumatic Vacuum Cleaner. This air–operated vacuum cleaner is a small, portable unit for removing debris and water from aircraft (Appendix B).

3–4.7. Universal wash unit. The universal wash unit is used for general purpose cleaning. The operating procedures are given in paragraph 3–4.10.3.

3–4.8. Cabinet–style Parts Washer. This method of cleaning utilizes an industrial power washer that is comprised of an enclosed cabinet equipped with a system of spray impingement nozzles, cleaning solution heater, fluid pump, skimmer for oil and its residues, and separate reservoirs for cleaning solution and effluents. This cleaning process can effectively clean aircraft components by using aqueous cleaners applied at varying combinations of high temperatures and pressures for the chemical removal of soils, oils/greases, corrosion preventive compounds and other contaminants authorized for removal by the cognizant aircraft engineering authority. Operating instructions are given in paragraph 3–4.10.4.

3–4.9. Miscellaneous equipment. Accessories and consumable materials for manual operations, listed in Appendices A and B, include the following important items:

a. The Aircraft Washing Kit (3M No. 251) is a conformable plastic device with a surface for attaching cleaning pads and sponges. It attaches to a mop handle for cleaning hard–to–reach areas. Aircraft cleaning sponges (3M No. 261) have a crimped fiber backing for attachment to the aircraft washing kit.

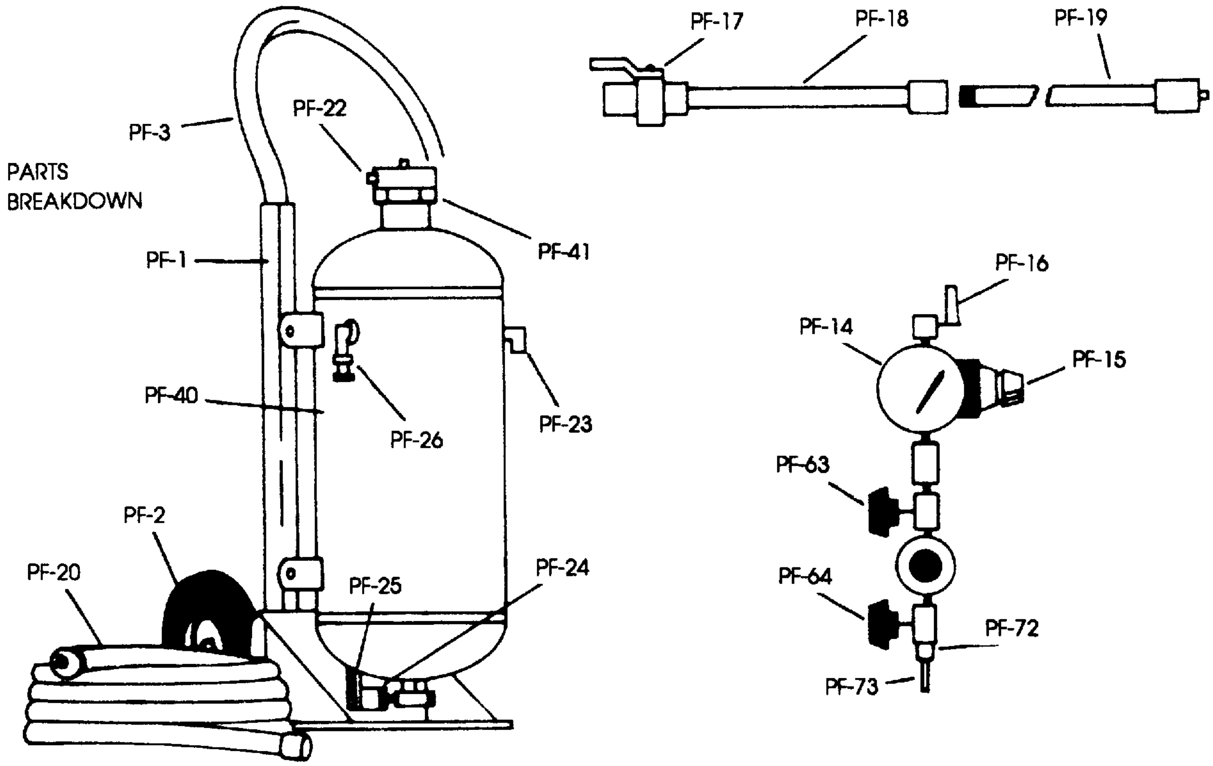
b. Non–metallic cleaning and polishing pads (A–A–3100) are crimped polyester fiber pads for detergent and solvent cleaning aircraft surfaces. Do not use them with paint removers.

c. Brushes, non–metalic bristles (MIL–B–23958, A–A–3080) are used with aircraft detergent cleaners, such as MIL–PRF–85570.

d. Cheesecloth (A–A–1491) and non–woven cloth (A–A–162, Type I, Class 7) are for cleaning critical areas where an exceptionally clean cloth is required, such as solvent cleaning prior to painting, adhesive bonding, or sealing.

e. Plastic spray bottles are used for applying diluted MIL–PRF–85570, Type I or II or concentrated Type V.

3–4.10. Equipment operating procedures. This section contains general operating instructions for the most commonly used large pieces of cleaning equipment.



TANK CAPACITY:	**15 GALLONS**
TANK DIMENSIONS:	**16” LONG x 17” WIDE x 42” HIGH**
TANK WEIGHT (EMPTY):	**68 POUNDS**
COMPRESSED AIR PRESSURE:	**40–110 PSI**
FILLER HATCH OPENING:	**3-1/4”**
AIR LINE INLET:	**1/4” (USE 3/8” OR 1/2” AIR LINE)**
CFM REQUIREMENTS:	**15 CFM**
TANK CONSTRUCTION:	**STAINLESS STEEL**
FOAMING HOSE DIMENSIONS:	**5/8” ID x 50’ LONG, 200 PSI**
SAFETY RELIEF VALVE:	**125 PSI**

PART NO.	DESCRIPTION	PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
PF-1	PORTABLE CARRIAGE	PF-18	SHORT WAND	PF-26	AIR BLEED VALVE
PF-2	WHEEL	PF-19	WAND EXTENSION	PF-40	COMPOUND TANK (20 GAL)
PF-3	CURVED HANDLE	PF-20	APPLICATION HOSE	PF-41	TANK CAP GASKET
PF-14	PRESSURE GAUGE	PF-22	TANK FILL CAP	PF-63	AIR METERING VALVE
PF-15	AIR REGULATOR	PF-23	SAFETY VALVE	PF-64	COMPOUND METERING VALVE
PF-16	AIR INLET VALVE	PF-24	CHECK VALVE	PF-72	SK FITTING (F)
PF-17	FOAM DISCHARGE VALVE	PF-25	SK FITTING (M)	PF-73	SS TUBING

NOTE: REPLACEMENT PARTS NOT AVAILABLE BY NSN. ORDER FROM MANUFACTURER.

Figure 3–1. Foam Generating Cleaning Unit (15 Gallons)

TANK CAPACITY:	45 GALLONS
TANK DIMENSIONS:	48” LONG x 27” WIDE x 37” HIGH
TANK WEIGHT (EMPTY):	175 POUNDS
COMPRESSED AIR PRESSURE:	40-110 PSI
FILLER HATCH OPENING:	3-1/4”
AIR LINE INLET:	1/4” (USE 3/8 OR 1/2” AIR LINE)
CFM REQUIREMENTS:	15 CFM
TANK CONSTRUCTION:	STAINLESS STEEL
FOAMING HOSE DIMENSIONS:	5/8” ID x 50’ LONG, 200 PSI
SAFETY RELIEF VALVE:	125 PSI

Figure 3-2. Foam Generating Cleaning Unit (45 Gallons)

3–4.10.1. Portable, 15 gallon, Foam Generating Cleaning Unit.

WARNING

Do not service the portable, 15 gallon, foam generating, cleaning unit without releasing pressure.

CAUTION

When cleaning task is completed, drain tank and flush to preclude an extremely strong solution from being used that could be damaging.

a. Release pressure prior to servicing.

b. Remove tank fill cap and fill container with appropriate diluted cleaning compound. Allow adequate air space at the top of the tank. Replace filler plug.

NOTE

Refer to Table 3–1 to mix the proper ratio of materials to be used.

c. Connect air supply to air inlet valve on air regulator.

d. Open compound metering valve to full open position.

e. Open air inlet valve and set air pressure regulator to 30–70 psi.

f. Open foam discharge valve and direct foam at object to be cleaned.

g. If foam is too wet, close compound metering valve slightly.

h. If foam is too dry, open compound metering valve slightly and close air metering valve slightly.

i. Allow foam to remain on the surface for up to one minute, but not long enough to dry; then scrub and rinse.

3–4.10.2. Portable, 45 gallon, Foam Generating and Cleaning Unit.

WARNING

Do not service the portable, 45 gallon, foam generating, cleaning unit without releasing pressure.

CAUTION

When cleaning task is completed, drain detergent solution from tank and flush with fresh water. This will prevent a build–up of highly concentrated solution, which may damage aircraft surfaces.

a. Release pressure prior to servicing.

b. If tank has been in prior use and is closed, close cleaning compound valve and air valve, then open air dump valve to bleed off retained air pressure.

c. Remove cover of tank. The cover is retained by several draw bolts.

d. Fill with cleaning compound in appropriate dilution, allowing for adequate air space at the top of the tank.

e. Replace cover, being sure it is firmly locked in place.

f. Close air and cleaning compound handle valves.

g. Attach air line to air inlet on side of unit. Fill and check air regulator to ensure proper pressure (30–70 psi).

h. Open air valve.

i. Open cleaning compound valve slowly until desired foam consistency is reached.

j. Apply foam to surface to be cleaned. Generally, thin uniform layers perform best. During initial setting of the unit, air and cleaning compound valves should be adjusted to give the desired foam consistency. Combinations of less air and more cleaning compound make a wet foam. Combinations of more air and less cleaning compound make a drier foam. Dry foams give greater dwell time and prolong cleaning action, but wet foams clean better.

k. Allow foam to remain for up to one minute, but not long enough to dry: then scrub and rinse.

3–4.10.3. Universal Wash Unit.

WARNING

Use the universal wash unit in the horizontal position only.

a. Connect the strainer unit to the intake hose.

b. Connect the wand and nozzle spray to the output (discharge) hose or connect the discharge quick disconnect to the aircraft wash manifold quick disconnect.

c. Insert the strainer unit into a container of water or cleaning solution.

d. Press the start or remote start switch; observe the pressure gage. It should immediately indicate an increase in pressure.

e. After the pressure reaches approximately 10 psig. release the start switch. The unit should continue to operate.

f. The unit will deliver approximately 2.5 gallons per minute at 30 psig.

g. Press the stop or remote switch to stop the unit from operating.

3–4.10.4. Cabinet–style Aqueous Parts Washer.

WARNING

The materials used and effluent generated from this cleaning process may be hazardous to operating personnel and the environment. Contact the local industrial hygienist or bioenvironmental engineer for guidance regarding personal protective equipment (PPE) and other health and safety precautions. Parts will be very hot after the cleaning process. Handle with thermally protective and water repellent gloves. Drain any entrapped solution back into the washer.

CAUTION

High pressure parts washers shall not be used for bearings unless specifically authorized.

Due to the maximum allowable pH (pH 13.5) that the required cleaning compound, MIL–C–29602, can reach, cognizant engineering authority approval is required before cleaning aluminum alloy and IVD aluminum coated parts.

High pressure parts washers have been implemented to replace the use of 1,1,1 Tri–chloroethane vapor degreasing and to reduce the dependence upon MIL–PRF–680 Type II. It is suitable for degreasing disassembled components. Blast pressures in the spray cabinets may range from 40 to 100 Psi depending upon the equipment used. The washers are equipped with oil skimming devices, and particulate filtration devices to extend the life of the cleaning solution.

It is imperative that suitable fixtures and/or baskets are used to secure components during the cleaning cycle. Failure to do so may result in damage to the components being cleaned by the high pressure impingement spray.

a. Determine the reservoir capacity of your parts washer. Fill the reservoir with a solution of MIL–C–29602 cleaning compound, diluted per manufacturer's recommended concentration.

NOTE

Do not use the parts washer until the cleaning solution has stabilized at the required temperature. Agitation of the solution prior to reaching elevated temperatures may result in excessive foaming of the cleaning solution.

b. Allow cleaning solution to stabilize at manufacturer's recommended temperature or at 140_ to 180_F.

CAUTION

Caution shall be exercised when loading components with areas which can entrap water. Position parts in the cabinet and baskets such that the cavities which can hold or entrap water are face down.

c. Place components to be cleaned into parts washer. Components shall be secured to the turntable, or placed in a basket that is secured to the turntable.

CAUTION

Parts shall not be left unattended in the washing cabinet. Once the cleaning cycle is complete, the inside environment of the cabinet will become very hot and humid. Parts left unattended, or not removed within the required time, may develop corrosion. Follow the recommended manufacturer's instructions for the removal of cleaned parts.

d. Set the wash cycle timer for 3 to 30 minutes depending upon the type of soil to be removed and the quantity of soil on the parts. For light degreasing, a 3 minute cycle may be sufficient while heavily soiled and baked on grease may require a full 30 minute cycle. Run the wash cycle, and allow components to cool before handling.

e. If the cleaned part is subjected to an immediate inline process, i.e., fluorescent penetrant inspection, or painting, or in cases where precision cleaning is required, rinse the part with fresh clean water and thoroughly dry.

f. Apply MIL–C–81309, Type II, followed by MIL–PRF–16173, Grade 4 on bare steel parts which have been cleaned/rinsed and will be left unprotected from corrosive environments or will not be processed.

3–5. CLEANING PROCEDURES. Where high outdoor temperatures are encountered (80_F (27_C) and above) and where shade is not available, cleaning operations should be scheduled for early morning and late afternoon or night. Wetting aircraft exteriors with fresh water before cleaning will cool surfaces and help prevent fast evaporation during hot weather. For cold weather procedures, refer to paragraph 3–5.3.9.

3–5.1. Warnings and cautions. The following warnings and cautions shall be observed during aircraft cleaning operations:

3–5.1.1. Electrical.

WARNING

Aircraft and/or other equipment shall not be washed, cleaned, or inspected on an outdoor washrack when an electrical storm is in the immediate area.

Open all circuit breakers associated with battery power (refer to applicable aircraft manuals) prior to application of flammable solvent cleaners.

In order to guard against the danger of static electricity, aircraft shall be electrically grounded during all cleaning operations and when moored or parked.

Before cleaning electrical and avionic equipment, make sure electrical power is disconnected. Injury or death may otherwise result.

3–5.1.2. Personal protection. Consult the local safety office for personal protective equipment (PPE) requirements.

WARNING

Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compounds MIL–PRF–85570, or MIL–PRF–85704. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water.

Cleaning solutions are slippery. Maintenance stands will be used, where practical. Safety harness and safety lines must be used when standing on upper surfaces of aircraft during cleaning operations.

3–5.1.3. Use of solvents.

WARNING

Do not use synthetic wiping cloths with flammable solvents, such as aliphatic naphtha (TT–N–95).

Solvents shall not be applied with atomizing spray equipment. This is not only hazardous, but violates environmental regulations in most areas.

Keep all solvents away from open flames and any live electrical circuit or sources of electrical arcing. Ensure that residual solvent is removed from aircraft, engine bays, and equipment.

Use solvents in well-ventilated areas. Wear rubber gloves and chemical or splash proof goggles. Avoid skin contact. Consult the local safety office regarding respiratory protection.

Do not mix cleaning compound with any solvent (i.e., MIL-PRF-680). The added solvents will create a fire hazard and a serious disposal problem, and can cause damage to nonmetallic materials.

3-5.1.4. Use of cleaners.

CAUTION

Steam shall not be used for cleaning aircraft or components.

Do not apply MIL-PRF-85570 (except Type II), or MIL-PRF-85704, Type I cleaning solutions or any unauthorized solvents to electrical wiring or plastic aircraft canopies, as it may cause damage to insulation or crazing of transparent surfaces.

Do not use cleaning compounds at higher concentrations than those recommended. Do not allow cleaning solutions to dry on aircraft surfaces. Such practices will cause streaking and can damage aircraft finishes and components.

3-5.1.5. Water intrusion.

CAUTION

To prevent entrapment of water, solvents, and other cleaning solutions inside of aircraft parts and structural areas, all drain holes, flap valves, etc,. shall be opened before washing to ensure that proper drainage occurs.

Do not wash or rinse aircraft with a solid stream of water. Use a soft spray pattern to avoid damaging fragile sections or causing water intrusion.

Water must not be directed at pitot tubes, static ports, vents. etc. These areas shall be adequately protected.

Relubricate all fittings and other lube points in areas to which cleaning compounds have been applied, such as wheel wells, flap wells, flight control wells, etc. Ensure that these areas are adequately drained and check the specific aircraft manual to determine lubrication requirements.

3-5.1.6. Oxygen systems.

CAUTION

Observe warnings and cautions in specific oxygen system manuals.

3-5.1.7. Special precautions.

CAUTION

Use extreme care when cleaning and related treatment is performed around radomes, access doors to integral fuel tank cells, light fixtures, electrical components, antennas, etc. These areas may be damaged by cleaning and related equipment.

3-5.2. Preparation for cleaning.

WARNING

Open all circuit breakers associated with battery power (refer to applicable aircraft manuals) prior to application of any flammable solvent.

CAUTION

Cover acrylic or polycarbonate canopies during shore based washing to prevent accidental scratching or crazing by cleaning compounds. Cover canopy with flannel cloth (A-A-50129, Type II). Cover flannel with barrier material (MIL-PRF-131, Class I), and tape to canopy frame or painted surface near canopy using preservation tape (AMS-T-22085, Type II) or masking tape

(AMS-T-21595, Type III). Do not apply tape directly to transparent surface.

3-5.2.1. Pre-wash lubrication. (For Navy aircraft only). To protect against cleaning solution entrapment, inspect all lubrication points that have exposure type lubrication fittings. Prior to lubricating any components or parts, remove all foreign matter from joints, fittings, and bearing surfaces, using non-woven cleaning cloth. Wipe up all spilled or excess oil and grease. Lubricate all fittings which will be exposed to wash solutions, in accordance with maintenance manuals or maintenance cards. If fittings do not accept lubrication, replace and lube prior to wash. See applicable maintenance manual and paragraph 3-6 for lubrication of aircraft components.

3-5.2.2. Water/cleaning compound intrusion. Take the following steps to prevent water/cleaning compound intrusion during cleaning:

a. Close doors and emergency openings.

b. Check drain holes. Make sure that all drain holes are clear by inserting a probe (such as a pipe cleaner), except where pressurized flapper valves are located. Refer to aircraft maintenance manuals for locations of drain holes.

CAUTION

Make sure that static vent/openings/ports are not fouled by tape adhesive transfer. Cover static vents by cutting a circle of barrier material (MIL-PRF-131, Class 1) to the same size as the vents, and hold in place with preservation tape (AMS-T-22085 Type II) or masking tape (AMS-T-21595, Type III, preferred by Air Force).

c. Cover vents, openings, and ports. Refer to aircraft maintenance manuals for locations of vents to be masked. Pitot static ports shall be covered. If covers are not available, barrier material (MIL-PRF-131, Class I) may be cut into circular pieces and taped in place with preservation tape (AMS-T-22085). Covers must be removed prior to release of aircraft for flight. Particular care shall be taken to ensure that static vents are not fouled by tape adhesive transfer. In the event of significant adhesive transfer, clean with aliphatic naphtha (TT-N-95).

CAUTION

Do not use a direct spray of water or cleaning compound on carbon brakes, wheels or wheel hubs. If wheel bearings are suspected of contamination, corrosion or loss of lubricant, remove wheel bearings and relubricate in accordance with applicable maintenance instructions. If carbon brakes are suspected of contamination, decontaminate per applicable maintenance instructions.

d. Cover wheels with locally fabricated covers to prevent water/cleaning compound contamination of wheel bearings and carbon brakes. Carbon brakes have temporarily reduced performance when subjected to water, deicers, degreasers, and oil. Brakes should be protected from direct impingement as much as practical during maintenance, aircraft cleaning or operations. Weak or spongy brakes (and in some cases, smoke) may result until the contaminants are burned off (normally one flight).

3-5.3. Cleaning methods.

WARNING

Wear rubber gloves, chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compounds MIL-PRF-85570, or MIL-PRF-85704. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water.

Open all circuit breakers associated with battery power (refer to applicable aircraft manuals) prior to application of flammable solvents.

3-5.3.1. The methods for cleaning aircraft vary depending upon the availability of fresh water. The following methods should be used for cleaning aircraft exterior surfaces. See Table 3-1 for instructions on specific areas and components.

3-5.3.2. Detergent cleaning (preferred method).

CAUTION

Do not use abrasive mats (A-A-58054) for cleaning painted surfaces.

3-5.3.3. The following procedure shall be used where fresh water is available for rinsing purposes. Dilute cleaner as recommended in Table 3-1. For additional Air Force requirements, see Appendix E.

a. Rinse aircraft surfaces where necessary to reduce skin temperature. Streaking will occur if cleaning solutions drip down hot painted surfaces.

b. Apply diluted cleaning compound (MIL-PRF-85570, Type I or II) from a bucket, spraying equipment, or foaming equipment. Scrub surfaces with Aircraft Washing Kit No. 251 fitted with a cleaning pad or sponge (See Figure 3-3) or with a cleaning brush. To prevent streaking, start at the lower surfaces, working upward and out (See Figure 3-4). Surfaces being cleaned should be exposed to cleaning solution for 5 to 10 minutes.

c. Rinse away the loosened soil and cleaner with fresh water. For rinsing, a rubber padded shut-off spray nozzle is recommended (see Figure 3-6). Rinse the cleaner and loosened soil from aircraft surface with a fan spray nozzle, directed at an angle between 15 and 30 degrees from the surface. Continue rinsing until all evidence of cleaner and soils have been removed from aircraft.

d. For aircraft painted with a tactical paint scheme, ground-in soils (boot marks, smudges, etc.) can be cleaned with MIL-PRF-85570, Type IV spot cleaner. Blot cleaner on using a cleaning pad or sponge. After several minutes, scrub these areas with the pad and rinse thoroughly. When the rubber particles in this cleaner are rubbed with the pad, removable soils are erased from the pores in the paint.

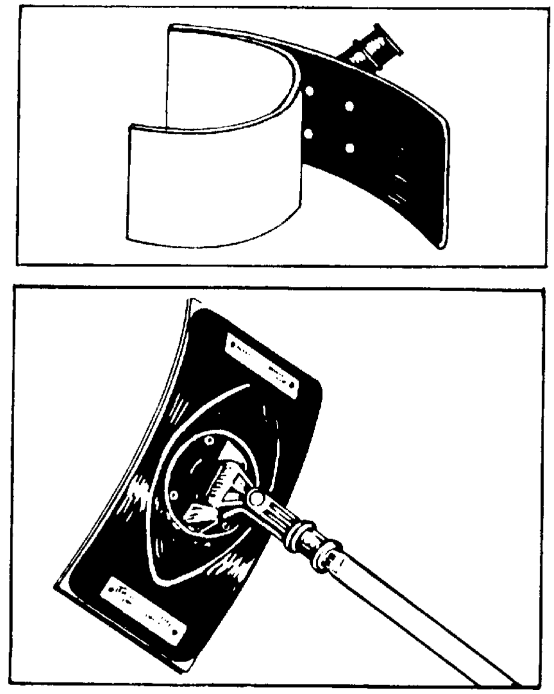


Figure 3-3. Use of Aircraft Washing Applicator

e. Wheel wells, flap wells and other heavily soiled areas which can tolerate water rinsing can be cleaned with MIL-PRF-85570, Type V gel cleaner. This cleaner may be sprayed on using a hand operated pump spray. After five to 15 minutes, rinse thoroughly with a coarse spray (See Figure 3-5).

3-5.3.4. Waterless wipe down. Waterless wipe down procedures for spot cleaning will be used only when water is not available for rinsing, or when cold weather prevents the use of water. The preferred waterless wipe down method for removing soils and corrosive salt residues is as follows:

a. Using a plastic spray bottle, apply MIL-PRF-85570, Type I or II, (one part cleaner to nine parts water) to the exterior surfaces of the aircraft (several square feet at a time).

b. After 30 seconds, scrub, then wipe cleaner and soil from the surface with a clean cloth.

c. Rinsing with a cloth wet with fresh water following the use of cleaner is desirable.

d. Rinse the cleaned surface with fresh water when it becomes available.

3-5.3.5. Alternate waterless wipe down. Use only when water is not available for rinsing or when cold weather prevents the use of water. The following is an alternate method of waterless wipe down:

a. Apply a film of a water displacing corrosion preventive compound (MIL-C-81309, Type II).

b. Wipe with a cloth to remove the loosened soil.

c. Apply a second coat of MIL-C-81309, Type II.

d. Wipe the surface with a clean cloth.

3-5.3.6. Detergent cleaning with limited water. Use the following procedure, only when sufficient rinse water is not available:

a. Mix either of the following in a bucket:

(1) One part MIL-PRF-85570, Type II and nine parts water or

(2) One part MIL-PRF-85570, Type I and 16 parts water.

b. Apply the cleaner with a cleaning pad, sponge, cloth, or cleaning brush. Apply to one small area at a time.

c. Scrub the area and wipe clean with a soft cloth.

d. For stubborn soils, clean with degreasing solvent MIL-PRF-680, Type II. Then scrub with one of the above solutions, or use:

(1) One part MIL-PRF-85570, Type II and one part water.

(2) One part MIL-PRF-85570, Type I and four parts water. Wipe clean with a soft cloth.

e. Apply MIL-C-81309, Type II and wipe with a clean, dry cloth.

3-5.3.7. Solvent cleaning. The use of MIL-PRF-85570 for stubborn or exceptionally oily areas on exhaust tracks, landing gears, wheel wells, and engine nacelles will normally be sufficient. When this material has not completely cleaned these areas, MIL-PRF-680, Type II can be used in small quantities. The quantity used shall be limited to the minimum necessary to accomplish the required cleaning. In using MIL-PRF-680 for cleaning, remember that it will burn intensely once ignited. Solvent available at the aircraft or equipment will therefore not exceed three gallons under the use or control of each person authorized to accomplish the cleaning involved. The authorized person will be thoroughly familiar with applicable safety precaution and disposal information. The time (dwell) the solvent is allowed to remain on painted surfaces shall be held to a minimum (10-15 minutes maximum) to prevent softening of the paint. Drain off of any dirty solvent resulting from the cleaning operation will be controlled to prevent unauthorized entry into the sewer. Minor spillage (less than one gallon) is not considered significant; however, solvent spillage should be cleaned up according to local regulations. In no instance shall the solvent be allowed to drain into or enter a public sewer or otherwise be allowed to contaminate streams or lakes. The following guidelines shall be followed in using MIL-PRF-680, Type II:

a. Use only in areas approved by the local safety office.

b. Ensure that the area within 50 feet of the solvent cleaning operation is clear and remains clear of all potential ignition sources.

c. Use only explosion-proof electrical devices and power equipment. Power units used in servicing shall be placed upwind and beyond the 50 feet clearance. Ensure that the aircraft or equipment is grounded.

d. No smoking shall be allowed in the solvent cleaning area.

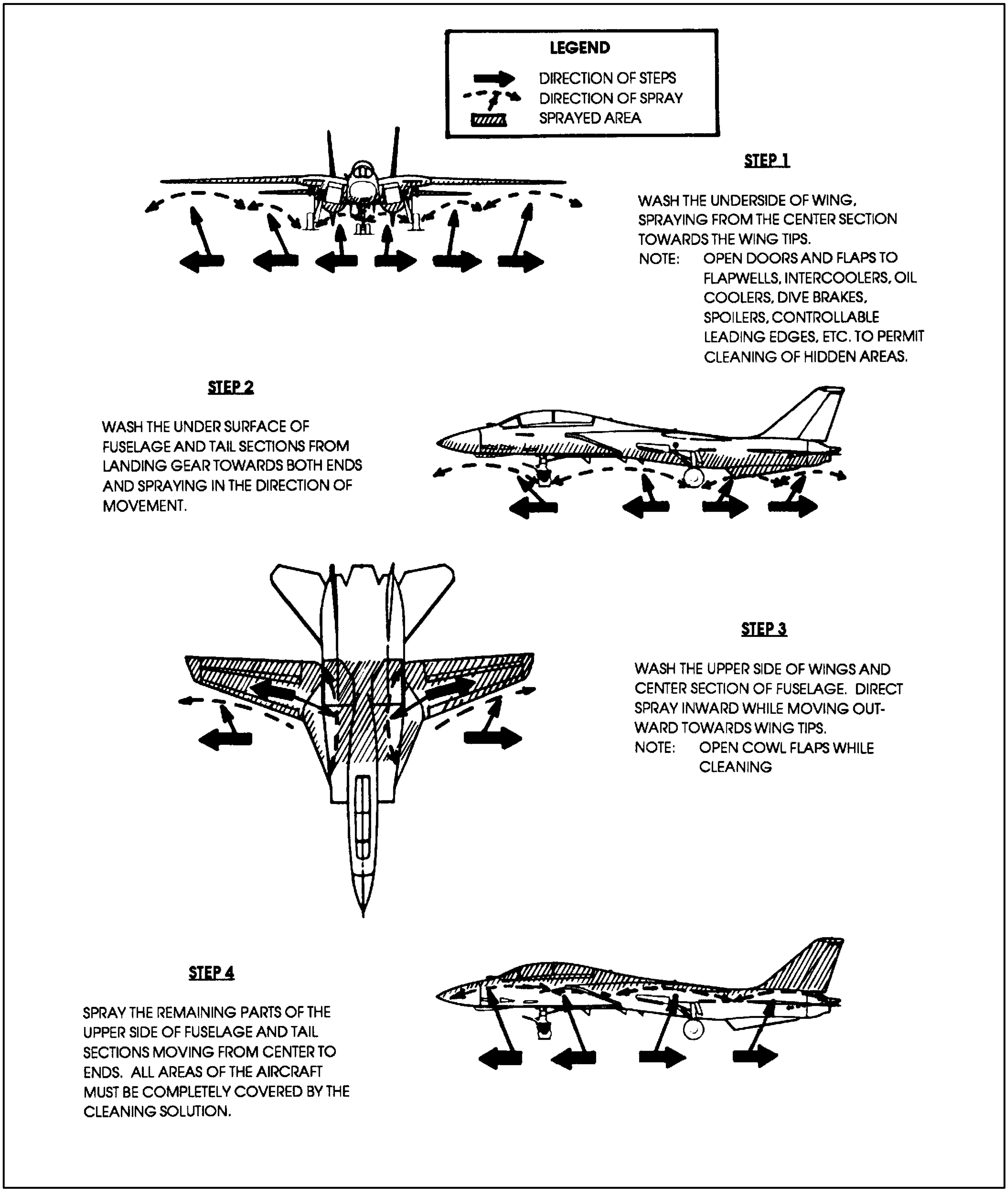


Figure 3-4. Aircraft Cleaning Procedure

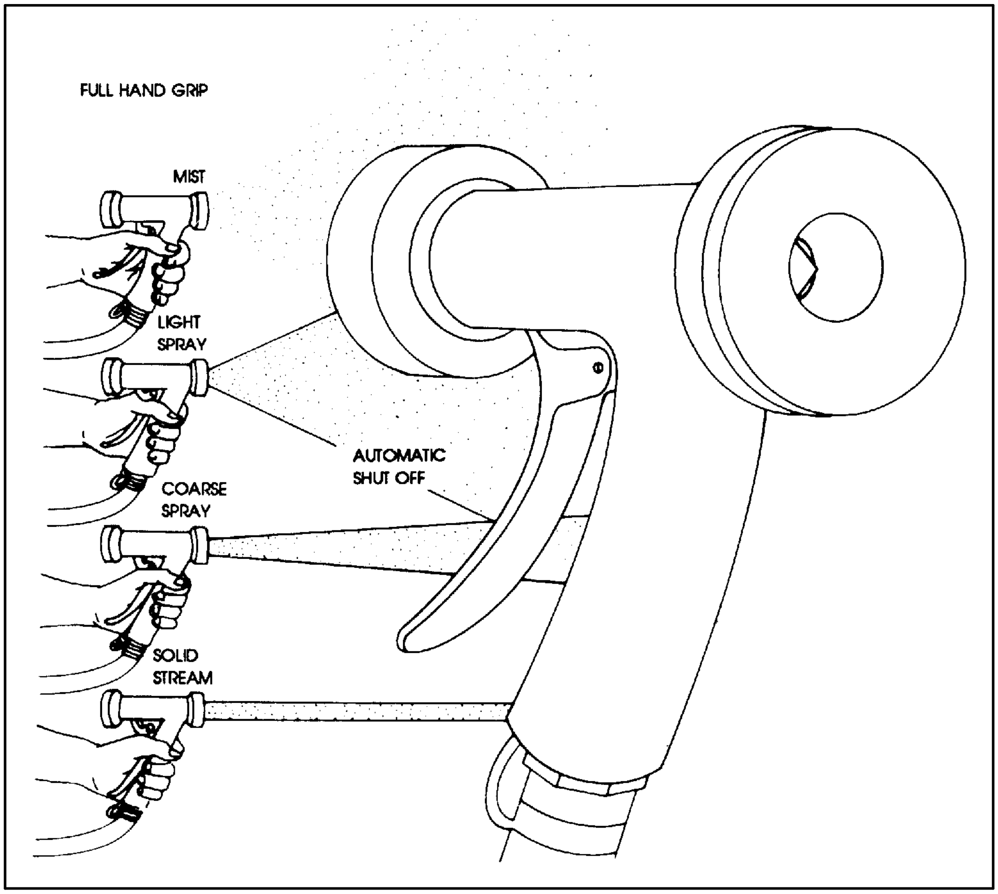


Figure 3-5. Automatic Water Spray Nozzle

e. Mixing of solvents with other chemicals, cleaning compounds, water, etc. is strictly prohibited except as specified by this manual.

f. Suitable fire extinguishing equipment shall be available to the solvent cleaning area.

g. Wear ANSI Z87.1, Type II goggles, protective wet weather clothing, solvent resistant gloves, boots, and head covering. Use a respirator fitted with organic vapor cartridges when working in an enclosed area. Ensure that good ventilation is maintained. Consult the local safety office for PPE requirements

h. Apply MIL-PRF-680, Type II using pad, cloth, or brush. Clean up solvent spills as they occur.

i. Ensure that no solvent is trapped or has entered the equipment interior. Remove by wiping with clean cotton wiping cloths or by blowing dry, using clean, low pressure air (10 - 15 psi).

j. Collect waste solvents and wiping rags and dispose in accordance with local regulations.

k. After cleaning with MIL-PRF-680, rewash these areas using procedures in paragraph 3-5.3.2 to remove residue left by the solvent.

3-5.3.8. Interior cleaning (vacuum). Dirt, dust, small loose objects, paper, etc. can be removed from an area by use of an industrial or domestic vacuum cleaner. A soft bristle brush on the inlet of the vacuum cleaner will aid in removal of soils.

a. Floor boards and areas underneath the floor boards (bilge) shall be inspected at depot maintenance and as may otherwise be required for conditions that would necessitate cleaning or corrosion removal and treatment. Particular attention shall be given to urinal areas.

CAUTION

Accidental spills shall be investigated immediately after occurrence to determine if ingredients are corrosive. Air Force: spills determined to be corrosive will be neutralized as directed by T.O. AFM 71–4. Navy (OPNAV 4110.2) and Army: neutralize corrosive spills by using procedures in Table 3–1. Failure to comply can result in extensive corrosion damage and possible unsafe operation of the equipment.

b. When it is determined that harmful contamination, (i.e., dirt spillage, foreign material, etc.) is present, remove the floor boards as necessary to allow proper cleaning of the area.

c. The area will then be cleaned by vacuuming all loose foreign material, dirt, etc. The vacuum removal of dirt or soil may be aided by agitating with the brush. Be careful not to sweep or wipe the dirt, etc. into oily or wet areas.

WARNING

Use MIL–PRF–680, Type II with adequate ventilation and be sure bilge and/or other areas are properly ventilated (blown out) before floor boards are reinstalled or closed. Warning signs shall be conspicuously placed at all aircraft entrances to indicate that combustible materials are being used. The guidelines cited in paragraph 3–5.3.7 for solvent cleaning procedures apply.

d. Oily areas and/or spots may be cleaned by wiping area with a clean cloth dampened with solvent, MIL–PRF–680, Type II followed by immediate drying with a clean dry cloth. Do not over–saturate the cloth used for applying the solvent because this may result in the solvent puddling or entering recessed areas and creating a fire hazard. Precautions shall be taken when using the solvent around electrical equipment to prevent entry.

CAUTION

Before starting the following cleaning operation, be sure that the spray or other methods of application will not result in moisture damage to any components, especially electrical. Before using the spray methods, ensure all drain holes are open, that the material will drain and that the cleaning solution will not be forced into inaccessible areas. Do not apply the solution to any moisture absorbing material such as insulation, sponge rubber (open cell), felt, etc.

e. If further cleaning is required, use 1 part MIL–PRF–85570, Type II mixed with 9 parts fresh water. Air Force: see alternate cleaners in Appendix E. The cleaning solution can be applied by spraying or with a mop, sponge, or brush, provided that the solution can be adequately rinsed and/or removed from the surface.

f. After applying the cleaning solution with a non–metallic bristle brush, allow dwell time of approximately 10 minutes and flush or rinse with clean water. Check drain holes to assure that they are open and the water is draining properly. Remove any remaining water using clean cloths. The surface shall then be thoroughly dried using warm air or clean dry cloths.

g. In those areas where the above procedures cannot be used due to lack of drainage, possible damage to components, etc., hand cleaning procedures will have to be used. Apply 1 part MIL–PRF–85570, Type II mixed with 9 parts water, by wiping or agitating the surface with a wet rag or sponge. Air Force: see alternate cleaners in Appendix E. Immediately following the application of the solution, wipe the same area with a rag wetted with clean water and then with a dry rag. The procedure may have to be repeated several times on extremely soiled areas.

h. Where corrosion is encountered or paint is removed, treat it in accordance with this manual and the applicable maintenance instruction manual before the floor boards are replaced or area is closed.

Table 3–2. Recommended Dilution of Low Temperature Cleaner

AMBIENT TEMPERATURE	DILUTION (Parts mixture:parts water)
+30_F and above	1:4
+20_F to +30_F	1:2
+10_F and below	1:1

3–5.3.9. Low temperature cleaning.

WARNING

Deicing fluid (AMS 1424) is mildly toxic. Contact with skin and eyes shall be avoided. Do not inhale deicing fluid mist. Operators should stay on the windward side of the aircraft during spray or brush application. Chemical or splash proof goggles shall be worn by all maintenance personnel.

CAUTION

Isopropyl alcohol (TT–I–735) or any other alcohol shall not be used for deicing acrylic canopies. Use deicing fluid (AMS 1424) for these applications.

Routine scheduled cleaning should not be performed at temperatures below 40_F (5_C). Instead, aircraft should be cleaned in an indoor wash rack. If such a facility is not available and aircraft are contaminated by corrosive materials (such as runway deicer or salt water), contaminated areas will be cleaned even if the temperature is below 40_F (5_C). Normal cleaning solutions cannot be used in freezing weather. When the temperature is below or could drop below 32_F (0_C), clean as follows:

a. If necessary, deice aircraft according to NAVAIR 01–1A–520 (Navy), T.O. 42C–1–2 (Air Force), TM 55–1500–204–25/1 (Army) or applicable maintenance manuals.

b. Solvent clean heavily soiled areas of aircraft by wiping or brushing with degreasing solvent (MIL–PRF–680, Type II).

c. Dilute aircraft cleaning fluid (MIL–PRF–85570, Type II) with diluted deicing fluid (AMS 1424) to make a low temperature cleaner. If necessary, both materials should be warmed until the detergent can be poured into the deicing fluid. Mix thoroughly.

d. Dilute this mixture as required by Table 3–2.

e. Scrub the aircraft using a brush or aircraft washing kit.

f. Rinse by deicing as in step a. Heated deicing fluid mixtures will speed up the rinsing process.

3–5.4. Fresh water rinsing.

CAUTION

Do not rinse aircraft with a solid stream of water. Use a soft, spray pattern to avoid damaging fragile sections or causing water intrusion. Water must not be directed at pitot tubes, static ports, vents, etc. Critical areas shall be adequately protected with ground plugs, covers, etc.

Application of water in wheel wells, flap wells, flight control wells, etc., necessitates relubrication. Ensure that these areas are adequately drained and check the specific aircraft manual to determine lubrication requirements.

NOTE

Fresh water rinsing does not satisfy aircraft washing requirements.

3–5.4.1. The purpose of fresh water rinsing is primarily to remove salt from aircraft surfaces that have become contaminated due to operations near salt water. Most salt deposits are readily dissolved and/or dislodged and flushed away by rinsing. Rinsing can be done in a taxi–through facility or by direct manual spraying.

3–5.4.2. Taxi–through rinsing. Deluge rinse facilities are automatic installations located in a taxiway area for use by aircraft after flight through salt air. These installations provide multiple jet sprays of fresh water to cover the entire aircraft and rinse off salt and water soluble contaminants. Such facilities should be used as frequently as possible.

3–5.4.3. Manual application. The manual application of fresh water is accomplished through the use of a hand held hose or some piece of spraying equipment. The force or pressure used to apply the water is not as critical as the amount of water. Satisfactory results are achieved with an amount of water that will create a full flowing action over the surface. This will require a minimum of eight gallons per minute (gpm) of water at not less than 25 psi or standard pressure. Maximum nozzle pressure shall not exceed 175 psi. Rinse as follows:

a. Direct water at an angle of 15 to 30 degrees from the surface. Ensure that sufficient water flow is achieved on all surfaces.

b. Begin rinsing on lower surfaces and work upward. (See Figure 3–4). Then rinse from the top down starting with vertical stabilizer, then upper fuselage, upper wing surfaces, and horizontal stabilizers. Lower areas will be rinsed in the same order and manner as upper surfaces.

3–5.5. Post cleaning procedures.

WARNING

Do not use synthetic wiping cloths with flammable solvents.

3–5.5.1. Corrosion prevention depends on carrying out the prescribed preservation and lubrication procedures. Strict compliance with the following procedures is essential. Post–cleaning procedures shall be done in the following order.

a. Remove covers and masking from all static vents, pitot tubes, air ducts, heater ducts. etc.

b. Remove tape from all other openings sealed with masking tape.

c. Remove all tape adhesive residues with degreasing solvent (MIL–PRF–680, Type II).

d. Clean all drain holes by inserting a probe, such as a pipe cleaner.

e. Ensure that all areas accumulating water have been drained. Whenever this is a recurring problem, procedures shall be developed and implemented to remove entrapped water and prevent accumulation.

CAUTION

Lubrication must be accomplished as soon as possible so as to prevent/minimize the occurrence of corrosion.

f. Upon completion of all cleaning operations, lubricate in accordance with applicable maintenance manuals to displace any entrapped water or cleaning materials. Water which is not displaced can cause corrosion and failure of lubricated parts.

g. Apply operational preservatives (paragraph 3–7) when necessary. Cleaning compounds tend to remove preservatives, making previously protected surfaces vulnerable to corrosion.

3–5.6. Treatment and disposal of washing rack waste.

NOTE

Cleaning solutions which remove greases and surface contamination from aircraft and components may exceed discharge concentration limits on oil and grease (especially where oil/water separators are not installed or not operating properly), naphthalene (from cleaners containing aromatic hydrocarbons), chromium, cadmium, nickel or other heavy metals (from cleaning operations involving engines or plated parts). If your wash rack is a source of hazardous waste, consult your base safety or environmental office to determine corrective action.

a. Precautionary measures shall be taken to prevent wash rack waste from contaminating lakes, streams, or other natural environments. Some of the chemicals used for cleaning require treatment or other special control prior to disposal.

b. The disposal of materials shall be accomplished in accordance with applicable directives and in a manner that will not result in the violation of local, state, or Federal pollution criteria.

c. To facilitate the problems associated with disposal and the actual cleaning process, all work shall be accomplished on an approved washrack. The only exception to this requirement shall be for those facilities which are temporarily established to support combat operations or special missions.

d. Aircraft washrack cleaning waste shall receive the equivalent of secondary sewage treatment. When MIL–PRF–85704, Type I solvent emulsion cleaning solution is used, waste shall be released so that the total effluent entering the waste treatment plant does not contain more than the amount limited by local environmental regulations or 100 parts per million (ppm) of cleaning compound.

CHAPTER 3

PREVENTIVE MAINTENANCE

SECTION II. LUBRICATION

3–6. INTRODUCTION. Lubrication performs a dual purpose. It not only prevents wear between moving parts, but also fills air spaces, displaces water, and provides a barrier against corrosive media. The lubrication requirements contained in maintenance manuals and maintenance cards are usually adequate to prevent corrosion of most lubricated surfaces under normal operating conditions at shore bases. However, these required intervals shall be shortened when operating aboard ship, especially under foul weather conditions. Aircraft lubrication shall be accomplished by personnel qualified in lubrication procedures. In the event that the specified lubricant is not available, request substitutions through the chain of command.

NOTE

Comply with relubrication time frame requirements outlined in the system specific manual.

3–6.1. Conventional lubricants.

CAUTION

Not all lubricating materials are compatible. Some are known to promote corrosion or cause paint or acrylic plastics to deteriorate. The use of the correct lubricating material is critical. Do not use greases or oils with solid film lubricants. Use only lubricants specified by appropriate manuals or maintenance cards.

Do not lubricate Teflon bearings and bushings. Clean Teflon bearings and bushings with degreasing solvent MIL–PRF–680, Type II.

Lubricants containing graphite, either alone or in mixture with any other lubricants, shall not be used, since graphite is cathodic to most metals and will cause galvanic corrosion in the presence of electrolytes.

3–6.1.1. Table 3–3 contains the title, specification, intended use, and temperature range of the most frequently used conventional lubricating materials.

3–6.2. Solid film lubricants. These lubricants prevent galvanic coupling on close tolerance fittings and reduce fretting. Solid film lubricants are used where conventional lubricants are difficult to apply or retain or where other lubricants may be contaminated with dust, wear products or moisture. Typical applications of solid film lubricants are sliding motion components such as flap tracks, hinges, turnbuckles and cargo latches.

CAUTION

Do not use solid film lubricants in areas subject to rotational speeds above 100 rpm under heavy loads or on roller bearing elements.

Do not use solid film lubricants in conjunction with oils or greases.

3–6.2.1. Surface preparation is extremely important to the service wear life of solid film lubricants. They are usually applied over surfaces pre–coated with other films, such as anodize (aluminum and magnesium base material) and phosphate (steel base material). They have also been successfully applied over organic coatings such as epoxy primers.

3–6.2.2. MIL–L–46010 (Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting) is a heat cured, corrosion–inhibiting solid film lubricant with extended wear life. It can be used on aluminum, copper, steel, stainless steel, and titanium. It is used in areas of infrequent operation and in areas requiring long term protection under static conditions. Because MIL–L–46010 must be cured at

400_F (204_C) for one hour or if metallurgical damage is done at this temperature, 300_F (149_C) for two hours, it is not suitable for all applications.

3-6.2.3. MIL-L-23398 (Lubricant, Solid Film, Air Cured, Corrosion Inhibiting) is an air-cured, corrosion-inhibiting solid film lubricant which may also be used to repair surfaces originally coated with MIL-L-46010. It can be used on aluminum, steel and titanium. It provides moderate wear life and corrosion protection in areas where it is not feasible to use a solid film lubricant that requires curing at elevated temperatures.

3-6.3. Application of conventional lubricants.

CAUTION

When lubricating hinges and pinned joints, apply MIL-C-81309, Type II before applying lubricant, or apply MIL-L-63460. Always apply generous quantities of lubricant, and actuate the hinge several times to make sure that the lubricant penetrates all crevices thoroughly.

3-6.3.1. Lubricants should be applied sparingly to prevent accumulation of dust, dirt, and other foreign matter. Wipe away any excess lubricant. The proper method of application is important. Apply as specified in the appropriate maintenance manual. Lubricants can be applied by one of the following methods:

a. Grease guns: lever or pressure type;

b. Oil, squirt, and aerosol spray cans; or

c. Hand or brush.

3-6.3.2. Grease gun application. When applying lubricants through pressure type fittings with a grease gun, clean grease fitting with degreasing solvent (MIL-PRF-680) and a clean cloth before applying lubricant. Make sure the lubricant has emerged around the bushing. If no grease appears, check the fitting and grease gun for proper operation. Be certain the grease gun is properly attached to the fitting prior to applying pressure. When applying grease to a flush type (high pressure) fitting, make sure that the grease gun is fitted with a flush type adapter and held perpendicular to the surface of the fitting before applying pressure. If the fitting does not accept lubrication, replace the fitting and lubricate. Wipe excess grease from fitting with a clean, dry cloth.

Table 3–3. Common Military Greases and Their Uses

Specification and Nomenclature	Intended Use	Recommended Temperature Range
AMS–G–4343 Grease, Pneumatic System (NATO Code G–392)	Lubrication between rubber to metal parts of pneumatic systems; pressurized cabin bulkhead grommets and other mechanisms requiring rubber to metal lubrication.	–65_F to 200_F (–54_C to 93_C)
AMS–G–6032 Grease, Plug Valve, Gasoline and Oil Resistant (NATO Code G–363)	Tapered plug valves; gasket lubricant or seal; general plug valve and fitting use where gasoline, oil, alcohol, or water resistance is required.	–32_F to 200_F (0_C to 93_C)
MIL–G–21164 Grease, Molydenum Disulfide, for Low and High Temperatures (NATO Code G–353)	Heavily loaded steel sliding surfaces, accessory splines, or anti–friction bearings carrying high loads and operating in wide temperature ranges where grease will prevent or delay seizure in the event of inadequate lubrication.	–100_F to 250_F (–73_C to 121_C)
MIL–PRF–23827 Grease, Aircraft and Instrument, Gear and Actuator Screw (NATO Code G–354)	Sliding and rolling surfaces of such equipment as instruments, cameras, electronic gear and aircraft control systems that are subject to extreme marine and low temperature conditions; ball, roller and needle bearings; gears; low torque equipment; general use on aircraft gears and actuator screws.	–100_F to 250_F (–73_C to 121_C)
MIL–G–25013 Grease, Aircraft, Ball and Roller Bearing (NATO Code G–372)	Lubrication of ball and roller bearings that operate at extreme high or low temperatures, especially in applications where soap–type greases and oils cannot be used; aircraft actuators; gearboxes.	–100_F to 450_F (–73_C to 232_C)
MIL–G–25537 Grease, Aircraft, Helicopter, Oscillating Bearing (NATO Code G–366)	Lubrication of aircraft bearings having oscillating motion of small amplitude.	–65_F to 160_F (–54_C to 71_C)
MIL–PRF–27617 Grease, Aircraft Fuel and Oil Resistant	Lubrication of taper plug valves, gaskets, and bearings in fuel systems; lubrication of valves, threads, and bearings in liquid oxygen systems. Do not use on aluminum or magnesium dynamic bearings due to possible ignition hazard.	–30_F to 400_F (–34_C to 204_C)
MIL–PRF–81322 Grease, Aircraft, General Purpose, Wide Temperature Range	NLGI Grade 1: arresting gear sheave spacers and other equipment that operates under high contact loads and high sliding speeds NLGI Grade 2: aircraft wheel bearings and internal brake wheel assemblies, antifriction bearings, gearboxes, and plain bearings (NATO Code G–395).	–65_F to 350_F (–54_C to 177_C)

CHAPTER 3

PREVENTIVE MAINTENANCE

SECTION III. PRESERVATION

3-7. INTRODUCTION. Corrosion preventive compounds (CPCs), or preservatives, are used to protect metal aircraft parts and components. They function by preventing corrosive materials from contacting and corroding bare metal surfaces. Many of these compounds are also able to displace water, sea water, and other contaminants from the surfaces to be protected. Some provide lubrication, as well as corrosion protection. Generally, CPCs are mixtures of special additives in petroleum derivative bases (special oils or greases). CPCs range in appearance and consistency from the thick, black types, such as MIL-PRF-16173, Grade 1, to light oils, such as VV-L-800. The thicker CPCs provide the best corrosion protection, are longer lasting, and are more difficult to remove. The thinner materials provide some lubrication and do not crack, chip or peel but must be removed and replaced regularly to provide continuing protection. Navy: refer to NAVAIR 15-01-500 for detailed information on preservation of aircraft and components.

3-7.1. Operational preservation. The day to day application of CPCs to prevent corrosion on operational aircraft is known as operational preservation. Areas which are corrosion prone or where paint has been damaged should be routinely protected by CPCs until more permanent treatment (such as paint touchup or sealing) can be applied.

3-7.2. Non-operational preservation. Preservation of aircraft or components during periods of prolonged inactivity, storage, or shipment is known as non-operational preservation.

3-7.3. Types of CPCs. CPCs can be separated into two major categories: water displacing and non-water displacing compounds.

3-7.3.1. Water displacing compounds. Water displacing CPCs can be used to remove water, sea water, or other electrolytes from metal surfaces. MIL-C-81309, MIL-C-85054, MIL-L-63460, and VV-L-800 are examples of water displacing CPCs. These CPCs are able to penetrate into cracks, crevices, voids in faying edges, around fastener heads, and into hinges. They usually provide very thin coatings, one mil (0.001 inch) or less in thickness (a dollar bill is five mils thick), and are usually clear or translucent. Most water displacing compounds are soft, oily compounds which cannot provide long term protection outdoors or in areas which are frequently handled. MIL-C-85054 differs from the other water displacing compounds by forming a relatively hard, dry film, and therefore can be used for protection outdoors and in areas of frequent handling.

3-7.3.2. Non-water displacing compounds. Non-water displacing CPCs may be used on dried surfaces or on surfaces which have been first treated with a water displacing CPC. MIL-PRF-16173, Grades 1, 2 and 4 are examples of non-water displacing CPCs. They are heavier bodied oils or greases which provide long term corrodion protection. These CPCs provide thicker coatings and are light brown to very dark brown in color, with a waxy greasy appearance. They provide good corrosion protection and in areas where large amounts of water collect on or run off of structures.

3-7.4. Time limitations of CPCs. Because of their temporary nature, CPCs must be regularly removed and replaced to provide continuing corrosion protection. Table 3-4 provides the recommended time intervals for indoor and outdoor CPC application. Navy: Refer to NAVAIR 15-01-500 for further information on usage of CPCs.

Table 3–4 Time Limitations for CPCs

CPC	Outdoor[1]	Indoor[2]	Indoor Covered[3]
Soft Thin Films			
MIL–C–81309 Type II	14 Days	30 Days	180 Days
MIL–C–81309 Type III	5 Days	14 Days	90 Days
Lubrication and Protection			
VV–L–800	5 Days	30 Days	180 Days
Hard Thick Films			
MIL–C–85054	90 Days	210 Days	365 Days
MIL–PRF–16173 Grade 4	90 Days	210 Days	365 Days
MIL–PRF–16173 Grade 2	90 Days	210 Days	365 Days
MIL–PRF–16173 Grade 1	210 Days	365 Days	365 Days

1. Outdoor: Without cover; exposed to elements in a mild climate; absence of rain and other washing forces; free from air and water borne pollutants.
2. Indoor: Hangars, shop areas, storage or parts accumulation areas, warehouses.
3. Indoor covered: Items are wrapped or sealed in a water–resistant material, and stored indoors in a hangar, warehouse, or shop area. Soft thin film CPCs were designed for indoor use and ease of removal.

Table 3–5. Aircraft Corrosion Preventive Compounds

Specification and Nomenclature	Intended Use	Type of Coating
WATER–DISPLACING CPCs		
VV–L–800 Lubricating Oil General purpose, Preservative, (Water Displacing, Low Temperature)	Lubrication of hinge areas and wherever a low temperature, water displacing lubricant is required; requires frequent reapplications.	Soft, oily coating
MIL–L–63460 Lubricant, Cleaner, and Preservative for Weapons and Weapons Systems	Lubrication and short term preservation of aircraft hinges and small and large caliber weapons; facilitates the effective removal of firing residues, gums, and other contaminants from weapons components.	Thin, corrosion preventive lubricant

Table 3-5. Aircraft Corrosion Preventive Compounds (Cont.)

Specification and Nomenclature	Intended Use	Type of Coating
MIL-C-81309 Corrosion Preventive Compounds, Water Displacing, Ultra-thin Film		
Type II	Displacement of water; short term corrosion protection of metal surfaces during shipment, storage, and in-service use; corrosion protection of moving parts where some lubrication is required, such as hinge areas, bomb racks, and sliding parts. Also used as a waterless cleaner.	Soft, very thin (0.5 mil) translucent, light amber color
Type III	Displacement of water; corrosion protection of avionic equipment, electrical connector plugs and contact pins.	Soft, ultra thin film (0.2 mil), translucent, light amber color
MIL-C-85054 Corrosion Preventive Compound, Water Displacing, Clear (AMLGUARD)	Corrosion protection and water displacement for nonmoving parts, such as skin seams, installed fastener heads where paint has cracked, access panel edges, and areas with damaged paint.	Dry, thin (1.0 mil), clear, colorless
NON-WATER DISPLACING CPCs		
MIL-PRF-16173 Corrosion Preventive Compound, Solvent Cutback, Cold Application		
Grade 1	Protection of metal surfaces against corrosion when exposed with or without covering indoors or outdoors.	Hard, tack-free, thick (4.0 mils), dark brown or black color
Grade 2	Protection of metal surfaces against corrosion during rework or storage.	Soft, non-drying, thick (92.0 mils), light brown color
Grade 4	Protection of metal surfaces against corrosion during indoor storage when a transparent coating is required; coating of interior cables.	Soft, tack-free, thick (2.0 mils), light brown color

3-7.5. Description of CPCs. A list of CPCs and their intended uses is summarized in Table 3-5.

WARNING

MIL-C-85054 and MIL-C-81309 have been revised to eliminate ODS. Some products that have been reformulated are now flammable. Pay close attention to all CAUTION/WARNING labels on solvents and solvent-based products.

3-7.5.1. MIL-C-81309 (Corrosion Preventive Compound, Water Displacing, Ultra Thin Film). MIL-C-81309 is a general purpose corrosion preventive compound which can be used whenever a CPC or a water displacing compound is called for but no specification is referenced. MIL-C-81309 is to be used for indoor protection and short term protection where surfaces can be recoated when required. MIL-C-81309 materials are excellent water displacing compounds which provide an ultra thin, soft film (0.5 mil or less). The specification covers two types, both of which can be applied by dipping, spraying, brushing, or aerosol container. They provide temporary protection from corrosion and are easily removable with a solvent. They should not be used around liquid oxygen fittings.

3-7.5.1.1. Type II. A soft, thin film for general use, particularly on moving or sliding parts where some lubrication is needed, such as hinges or bomb racks. It may be washed away by rain or wash procedures. Type II shall be used to protect areas which cannot be properly drained or contain recesses that are particularly difficult to reach.

3-7.5.1.2. Type III. An ultra thin, soft film primarily for use on avionics and electronic equipment. Although this coating is nonconductive, it will allow electrical contact because it is soft and very thin.

3-7.5.2. MIL-C-85054 (Corrosion Preventive Compound (AMLGUARD). AMLGUARD is a water displacing CPC which forms a clear, dry, flexible film. It is intended for use as a protective coating until painting is practical. Because of its paint-like characteristics, it provides no lubrication.

CAUTION

Ensure that all areas where MIL-C-85054 is applied are fully dried before sealing an area. Although MIL-C-85054 is a corrosion preventive compound, its solvent vapors may cause corrosion if not allowed to dissipate.

3-7.5.2.1. AMLGUARD can be applied by dipping. brushing, spraying, or from aerosol containers; however, dipping provides a very thin coating with less corrosion protection. AMLGUARD is primarily applied by spraying from aerosol cans. After each use of an aerosol can, invert the can and spray until spray tip (nozzle) is clear of entrapped material. If an aerosol can does not spray, invert and depress the spray tip several times to clear the delivery tube and spray head. If the can still does not spray, remove and clean the plastic spray head then spray again to clear the delivery tube.

3-7.5.2.2. AMLGUARD should be removed if it is damaged due to abrasion, when there are cracks in the coating, or if there is evidence of corrosion below the coating. Since AMLGUARD buildup is difficult to remove, especially after prolonged exposure to direct sunlight, previously applied coatings should be removed before reapplication. If the solvents recommended in Table 3-6 do not remove old films of AMLGUARD, spraying on fresh AMLGUARD to soften the film and wiping or rubbing while wet is often effective.

3-7.5.3. MIL-PRF-16173 (Corrosion Preventive Compound, Solvent Cutback). MIL-PRF-16173 covers five different grades of CPC's which can be applied by brushing or dipping. Grades 1, 2, and 4 do not displace water and must be applied to dried surfaces or to surfaces which have first been treated with MIL-C-81309.

3-7.5.3.1. Grade 1. A thick, hard, black CPC which can be removed with difficulty using mineral spirits or paint removers. It offers the most corrosion protection of all the CPCs indoors and outdoors, and may be used at temperatures down to 0_F (-18_C).

Table 3-6. Preservation of Specific Areas and Components

Area or Component	CPC	Application Instructions	Removal Instructions
NOTE Prior to the application of preservatives, ensure removal of old coatings.			
EXTERIOR SURFACES NOT REQUIRING LUBRICATION	MIL-C-85054 or	Wipe off dirt and excess moisture. Apply thin coating of AMLGUARD. Allow to dry one-half hour. Apply a second coat.	Use a non-synthetic wiping cloth wet with degreasing solvent (MIL-PRF-680, Type II) or paint thinner (MIL-T-81772).
Unpainted areas and areas with damaged paint which do not require lubrication (fastener heads, faying surfaces, access panel edges, doors and frames, attachment points, non-moving attachment hardware, wheel well areas, ram air ducts, flap/slat cavities)	MIL-C-81309 Type II and MIL-PRF-16173 Grade 4	Wipe off dirt and excess moisture. Apply a coating of MIL-C-81309, followed by a coating of MIL-PRF-16173.	(For stubborn AMLGUARD refer to 3-7.5.2).
EXTERIOR SURFACES NOT REQUIRING HIGH PERFORMANCE LUBRICANT OR HYDRAULIC FLUID Sliding or moving parts requiring only minor lubrication (bomb racks, hinges, door locks)	MIL-L-63460 or MIL-C-81309 Type II and VV-L-800	Apply a continuous wet coat of MIL-L-63460. If handled reapply. Apply a coating of MIL-C-81309, followed by a coating of VV-L-800. If handled, reapply.	Use a non-synthetic wiping cloth wet with degreasing solvent (MIL-PRF-680, Type II).
THREADED SURFACES Screws, various fasteners	MIL-L-63460 or MIL-C-81309 Type II or MIL-PRF-16173 Grade 4	Dip screws or fasteners in CPC and install. When disassembly is frequent, use MIL-L-63460 or MIL-C-81309. When disassembly is infrequent, use MIL-PRF-16173 for long term protection.	Immerse screws or fasteners in degreasing solvent (MIL-PRF-680, Type II) and blot or blow dry.

Table 3–6. Preservation of Specific Areas and Components (Cont.)

Area or Component	CPC	Application Instructions	Removal Instructions
HYDRAULIC PISTON SURFACES	System hydraulic fluid	Wipe exposed surface with cloth dampened with hydraulic fluid, wiping away from seals. Take care not to scratch surfaces.	Do not remove. Reapply as necessary.
ELECTRICAL CONNECTOR SHELLS (EXTERIOR)		NOTE: For additional information refer to NAVAIR 16–1–540, T.O. 1–1–689, or TM 55–1500–343–23.	
Connector shells located in flap wells, wheel wells, bilge areas	MIL–C–85054 or	Wipe off dirt and excess moisture. Apply a thin coat of AMLGUARD. Do not allow CPC to contact internal surfaces. Allow to dry one–half hour. Apply a second coat.	Use a non–synthetic wiping cloth wet with degreasing solvent (MIL–PRF–680, Type II) or paint thinner (MIL–T–81772). For stubborn AMLGUARD refer to paragraph 3–7.5.2.
	MIL–C–81309 Type II and MIL–PRF–16173 Grade 4	Wipe off dirt and excess moisture. Apply coating of MIL–C–81309, followed by a coating of MIL–PRF–1673.	
ELECTRICAL CONNECTOR SHELLS (INTERIOR)		NOTE: For additional information refer to NAVAIR 16–1–540, T.O. 1–1–689 or TM 55–1500–343–23.	
Connector shells located in aircraft interior.	MIL–C–81309 Type II	Wipe off dirt and excess moisture. Apply a thin, uniform coating of CPC.	Use a non–synthetic wiping cloth wet with degreasing solvent (MIL–PRF–680, Type II).
ELECTRICAL CONNECTOR PINS (ALL)			
Connector pins and sockets	MIL–C–81309 Type III	Apply a continuous thin, wet coat. If handled or exposed to water, reapply.	Use an acid brush with non–synthetic bristles to apply degreasing solvent (MIL–PRF–680, Type II). Lightly dab all pins and blot dry. Repeat using isopropyl alcohol (TT–I–735).
ELECTRICAL AND ELECTRONIC EQUIPMENT	Refer to NAVAIR 16–1–540, T.O. 1–1–689, TM 55–1500–343–23, (Avionic Cleaning and Corrosion Prevention/Control)		

Table 3-6. Preservation of Specific Areas and Components (Cont.)

Area or Component	CPC	Application Instructions	Removal Instructions
CONTROL CABLES (INTERIOR)	MIL-C-81309 Type II and MIL-PRF-16173 Grade 4	Apply a continuous coating of MIL-C-81309 using aerosol can or wiping with cloth wet with CPC. Follow with a coating of MIL-PRF-16173 applied with a cloth.	Use a non-synthetic wiping cloth wet with degreasing solvent (MIL-PRF-680, Type II).
HELICOPTER CARGO HOIST DRUM	MIL-C-81309 Type II	Spray with MIL-C-81309. Wipe with a clean cloth to remove excess.	Use a non-synthetic wiping cloth wet with degreasing solvent (MIL-PRF-680, Type II) or paint thinner (MIL-T-81772).
	or		
	MIL-C-85054	Spray MIL-C-85054, with a continuous film. Allow to dry one half hour. Apply a second coat.	(For stubborn AMLGUARD refer to 3-7.5.2).
ARMAMENTS	Refer to specific instruction manual.		
EJECTION SEATS	Refer to specific ejection seat maintenance manuals and ACC/SPM instructions.		

3-7.5.3.2. Grade 2. A thick, soft, greaselike, brown CPC that remains tacky and can be removed with mineral spirits. It protects under relatively severe conditions and, given adequate maintenance touch-up as necessary, can be used for most maximum protection requirements. It may be used at temperatures down to -40_F (-40_C).

3-7.5.3.3. Grade 3. A thin, soft film, water-displacing CPC. It is not recommended for use on aluminum or magnesium parts. Use MIL-C-81309, Type II as a substitute.

NOTE

Remove MIL-PRF-16173 with degreasing solvent (MIL-PRF-680, Type II) when the coating is dark and prevents visual inspection of the underlying surface for cracks and hydraulic leaks.

3-7.5.3.4. Grade 4. A thin, relatively dry, semitransparent film through which identification can be read. It may be used at temperatures down to -40_F (-40_C).

CAUTION

If MIL-L-63460 is used in an area which will later be sealed, allow at least 4 hours for the solvent to evaporate prior to sealing. Although MIL-L-63460 is a corrosion preventive compound, its solvent vapors may cause corrosion if not allowed to dissipate.

Do not use MIL-L-63460 on rubber or other elastomeric parts. MIL-L-63460 contains solvents which attack rubber “O” rings and other elastomeric parts. Do not use as a direct substitute for VV-L-800.

3-7.5.4. MIL-L-63460 (Lubricant, Cleaner, and Preservative for Weapons and Weapon Systems). MIL-L-63460 is a thin, water displacing, protective, penetrating lubricant used for cleaning, lubrication, and preservation of aircraft hinges and small or large caliber weapons. This material has good lubricating properties between –65_ and 150_F (–54_ and 65_C). It may be applied by brushing, dipping, spraying, or from an aerosol container.

CAUTION

VV–L–800 material suffers a loss of viscosity at very low temperatures; therefore, it shall not be used when temperatures can drop below –40_F (–40_C).

3–7.5.5. VV–L–800 (Lubricating Oil, General Purpose, Preservative, Water Displacing). VV–L–800 is a general purpose, water displacing, lubricating oil with preservative properties, and is intended for the lubrication and preservation of aircraft components. It may be applied by brushing, dipping, spraying, or from an aerosol container. It should not be used in fuel cells or fuel systems.

CAUTION

Do not use corrosion preventive compounds on the interior of fuel tanks or fuel cells, engines, or engine fuel systems.

Do not use corrosion preventive compounds on engine parts or accessories which exceed 800_F (427_C). Hot corrosion reactions may occur.

CAUTION

CPCs are not compatible with liquid oxygen and should not be used on oxygen equipment, lines, fittings or storage bottles.

NOTE

Use only corrosion preventive compounds (CPCs) authorized by the parent service organization and described in this manual.

3–7.6. Preservation of specific areas. Table 3–6 provides procedures for the preservation of specific areas and components where the use of a CPC on exposed metal surfaces is generally recommended for reducing corrosion. This list does not constitute authority to use CPC's on specific equipment. The use of some or all types of CPCs in certain areas or on equipment may be detrimental. Therefore, consult the appropriate corrosion and maintenance manuals before applying a CPC in a new area and determine which, if any, compounds should be used in that area.

WARNING

CPCs and solvents can produce toxic vapors. Use only in well ventilated areas. Avoid contact with skin. Consult local safety office for personal protective equipment requirements.

Do not use synthetic wiping rags or cloths with these materials. Keep CPCs and solvents away from open flames or sparks.

3–7.7. Preservation application methods. CPCs can be applied by brushing, dipping, or spraying. The area of application, viscosity of the material, and conditions under which they need to be applied are factors which determine which method of application to use. Low viscosity materials are best applied by spraying, whereas high viscosity materials are more suited for brushing or dipping. Dipping can be used for all types of materials, but the thickness of the coating obtained with low viscosity materials may be too thin to provide adequate corrosion protection. Prior to application of preservatives, remove old preservative coatings, then apply using one of the following methods.

3–7.7.1. Brushing. Brushing may be accomplished using an ordinary paint brush. This method is most appropriate for applying thick materials, for use on small areas, or where it is necessary to prevent material from getting on surrounding areas or nearby equipment.

3–7.7.2. Dipping. Dipping may be accomplished using any suitable container for the CPC. It is most suitable for smaller disassembled parts. It cannot be used for assemblies which contain any part or area adversely affected by the CPC.

CAUTION

For spray application, do not thin or dilute bulk preservative unless absolutely necessary. Do not use synthetic wiping cloths. Mask off adjacent areas to prevent overspray.

3–7.7.3. Spraying. Spraying may be accomplished using paint spraying equipment, various types of sprayers, or aerosol containers. This method is very effective for application to large areas and where confinement is not a problem. The viscosity of the material will determine which type of spraying apparatus to use.

3–8. APPLICATION OF POLISH AND WAX. Polishing and waxing of aircraft exterior surfaces is prohibited unless authorized by parent service organization directives.

CHAPTER 4

INSPECTION AND CORROSION PRONE AREAS

SECTION I. INSPECTION

4–1. GENERAL.

4–1.1. Purpose. Frequent corrosion inspections are essential to the overall corrosion control program. By early detection, identification, and treatment, the costs resulting from corrosion are minimized. Without regular systematic inspections, corrosion will seriously damage aviation equipment. This chapter describes procedures for basic visual inspection for corrosion and describes some of the signs of corrosion damage.

4–1.2. Responsibility. Corrosion detection is everyone's responsibility. Since corrosion can occur almost anywhere on aviation equipment, all maintenance personnel must be able to identify and report corrosion problems. Personnel performing any scheduled inspections shall be qualified in corrosion detection and shall have attended appropriate corrosion courses as established by the parent service organization.

4–1.3. Frequency of inspections. The minimum frequency and extent of these inspections are established by parent service organization directives. However, during scheduled or unscheduled maintenance actions on aviation equipment or components, the area involved as well as those within 3 feet or 36 inches (18 inches on each side) of the repair or treatment area shall be visually inspected for corrosion. Additional inspections may be necessary in areas which are particularly prone to corrode, such as magnesium gear boxes, wheel and flap wells, bilge areas, etc. Areas which are corrosion prone are discussed in paragraph 4–5.

4–1.4. General inspections. A general inspection of aviation equipment is performed as follows:

a. Clean the area thoroughly (as described in paragraph 3–5) or wipe the area with a clean cloth dampened with dry cleaning solvent (MIL–PRF–680, Type II).

CAUTION

Prior to removing any access covers or panels primed with TT–P–2760 flexible primer, score the sealant at the edges of the cover/panel with a sharp plastic tool to prevent fraying the paint finish when the panel is removed.

b. If corrosion is suspected, examine the area with a 10X magnifying glass and flashlight. Examine edges of skin panels, rivet heads, and corrosion prone areas. If there are blisters, bubbles, or other coating irregularities present, attempt to dislodge the paint by scraping with a sharp plastic tool. If paint does not easily dislodge and corrosion is not suspected, the irregularity is probably confined to the paint film itself and no further action should be taken. When corrosion is suspected but no irregularities are present, apply a strip of 3M No. 250 (preferred) or A–A–883, Type II, flatback masking tape over the area (which must be clean and dry). Hand rub the tape for several strokes in order to assure good adhesion, and remove the tape with an abrupt lifting motion. Where paint is removed, inspect and determine the extent of corrosion (paragraph 4–4).

c. Remove corrosion, clean and treat the surface, and paint in accordance with Chapters 5 and 7.

4–1.5. Detailed inspections. A detailed inspection of aviation equipment shall be performed as a result of damage found during general inspections if extensive or severe corrosion is suspected, and as specified in appropriate aircraft maintenance documents. Equipment shall be carefully inspected for signs of corrosion using the tools and procedures listed in Table 4–1. See paragraph 4–5 for information on common corrosion prone areas.

Table 4–1. Inspection Equipment and Techniques

Equipment	Type of Corrosion Detected or Evaluated (See Type Below)
Borescope	1, 2, 3, 4, 5, 12
Depth Gage	1, 4, 5
Optical Micrometer	1, 2, 4, 5, 7, 8, 10
Fluorescent Penetrant	3, 4, 8, (13)
Eddy Current	1, 3, 4, 5, 8
Ultrasonic	1, 3, 4, 8, (13)
Radiography	(13)

Type:
1 Uniform surface corrosion
2 Galvanic or dissimilar metal corrosion
3 Intergranular attack (general)
4 Intergranular attack (exfoliation)
5 Pitting
6 Crevice attack in concentration cell corrosion (not detectable with NDI)
7 Fretting corrosion
8 Stress corrosion cracking
9 Corrosion fatigue (not detectable with NDI)
10 Filiform corrosion
11 Microbiologically induced corrosion (not detectable with NDI)
12 Hot corrosion
(13) Prescribed by higher authority

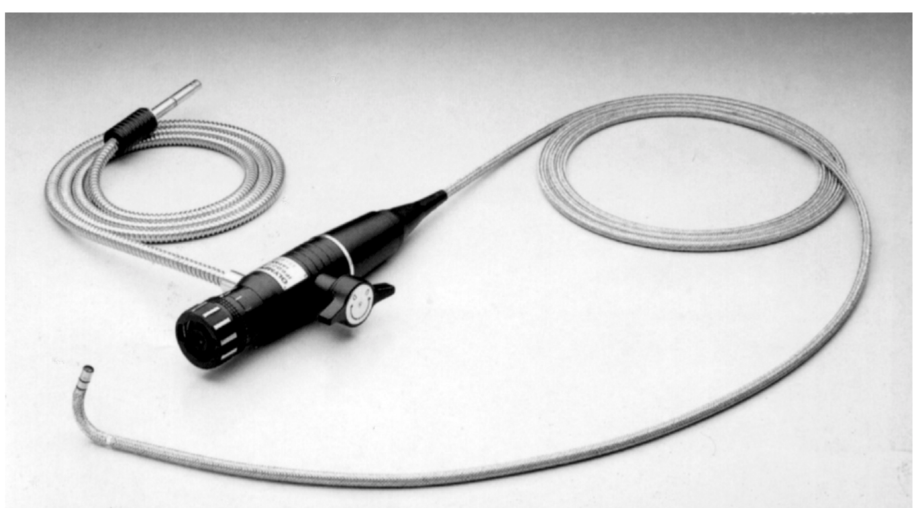


Figure 4–1. Fiber Optic Borescope

4–2. INSPECTION METHODS.

4–2.1. Visual inspection. Visual inspection is the most widely used method for the detection and evaluation of corrosion. It is very effective for detecting surface corrosion if done carefully and with a knowledge of where and what to look for. Read Chapter 2 (Corrosion Theory) before performing corrosion inspection, paying particular attention to Table 2–2 (Appearance of Corrosion Products). The following tools can be used to find and evaluate the extent of corrosion damage:

a. Flashlight

b. 10X Magnifying Glass

c. Plastic Scraper

d. Depth Gage, Pin Micrometer Type

e. Borescope

f. Optical Micrometer

4–2.1.1. Evidence of corrosion. Aluminum corrosion products will be white, gray, or black and may appear as a paste when wet or a hard, adherent film or easily crumbled deposits when dry. Magnesium corrosion products are white and form in large amounts with significant losses to the base metal. Steel corrosion products are red, brown, or black rust deposits which are easily detected. Copper corrosion products are blue or blue–green and are also easily detected. Titanium and stainless steels do not produce significant amounts of corrosion products but can exhibit stress corrosion cracking. When corrosion occurs beneath a paint system, the surface of the paint often appears blistered or distorted.

4–2.2. Depth gage. Depth gages are tools for measuring the depth of corrosion pits and reworked areas to determine the extent of corrosion present and the amount of metal removed during rework. If the pits or depth of rework are within allowable tolerances, as given in the specific aircraft publication or as described in paragraph 5–6, the pits can be acceptably cleaned, and the reworked area will require the re–application of a protective coating system. If the pits or depth of rework are not within allowable tolerances, the part must be replaced or repaired, if allowed, or a request for engineering assistance must be made.

NOTE

On thin sheet material, waviness in the material may result in false depth reading. Several readings may be necessary, or it may be necessary to improvise another method for determining the depth of the corrosion damage. The depth gage is not suitable for determining the depth of a corrosion crack due to the relatively large size of the indicator pin.

4–2.2.1. Use of depth gage. Several depth readings shall be taken in the affected area. Select the deepest reading as the depth of the corrosion damage. Where there are several damaged areas in the same skin panel or component part, plot or sketch a diagram of the depth and location of each damaged area. This diagram will be used for further evaluations, along with the applicable aircraft manuals, or when engineering assistance is required. The diagram should be forwarded to the engineer when requesting engineering assistance. The base of the depth gage shall be flat against the undamaged surface on each side of the corrosion damage area. When taking measurements on concave or convex surfaces, place the base perpendicular to the surface (Figure 4–2).

4–2.3. Visual inspection with borescope. The borescope has a small, high intensity light that can be used in the inspection of interior surfaces which are not accessible by any other method. Insert the head assembly into any cavity having a large enough opening. With the cavity illuminated, visually inspect its interior for defects, such as damage to the paint system and corrosion (Figure 4–1).

NOTE

Wearing eyeglasses makes it difficult to place the eye at the ideal distance from the eyepiece and the view is distorted by external glare and reflections. Rubber eyeshields on optical instruments (e.g. borescope, optical micrometer) are designed to shut out external light, but are not as effective when glasses are worn. For these reasons, it is desirable that the inspector be able to adjust the instrument without wearing glasses to compensate for variations in visual acuity.

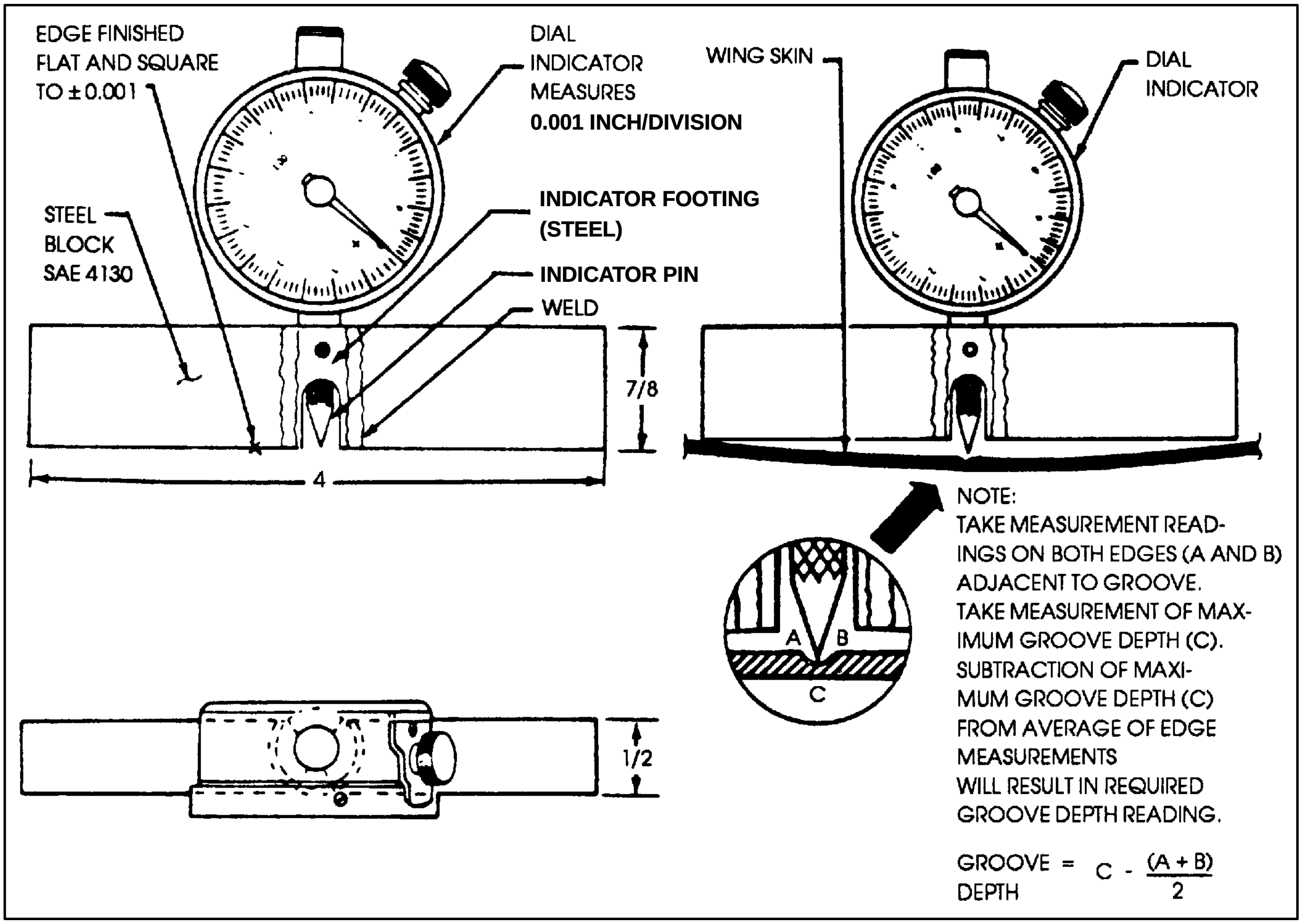


Figure 4-2. Depth Dimension of Corrosion Pits

4-2.4. Optical depth micrometer. This inspection tool measures the depth of scratches, cracks, and pits and the height on spurs and other protrusions (Figure 4-3). The micrometer is first focused on the highest surface in the area of interest and a reading is taken. A second reading is taken when the lowest surface is in focus. The difference between the readings is the distance between the two surfaces. Optical micrometers are available with 100 and 200 power magnification, reticle eyepieces, and accessory lighting. The procedures outlined below are to be used for determining the depth of corrosion pits and/or areas reworked due to corrosion damage on any surface using the optical depth micrometer.

a. Select the appropriate base to be used for the surface (e.g., flat, curved, round, or inside/outside angle surfaces) on which the measurement is to be made.

b. Position the micrometer solidly over the surface A (undamaged surface close to surface B) to be measured with lens directly over the area to be read. While the micrometer is set over the surface, a pin point of light will cover the area to be reviewed.

c. Look through the eyepiece of the micrometer and rotate the micrometer thimble clockwise or counterclockwise until surface A comes into sharp focus. Extreme care should be taken when focusing on the surface to be measured in order to reduce inaccuracy in the measured values.

d. Obtain the reading of surface A located on the vernier scale. Since the vernier scale is not one that can be simply read, an experienced technician should read the scale or assist/train someone else to read it.

e. Position the micrometer over surface B (corrosion pit or area reworked due to corrosion damage) to be measured. When measuring the depth of corrosion pits or reworked areas, ensure that the surface being measured has a large enough area to be focused in order to obtain an accurate reading.

f. Repeat procedures c. and d. on surface B.

g. Take the distance readings from surface A and surface B and subtract the surface A reading from the surface B reading to obtain the depth of the corrosion damaged surface. Calculate the pit depth using the following formula:

Pit Depth = Distance B – Distance A

h. Take several readings from the corrosion damaged surface and select the deepest reading as the pit depth.

CAUTION

The apparent simplicity of the penetrant inspection is deceptive. Very slight variations in performing the inspection process can invalidate the inspection by failing to indicate serious flaws. It is essential that personnel performing penetrant inspection be trained and experienced in the penetrant process.

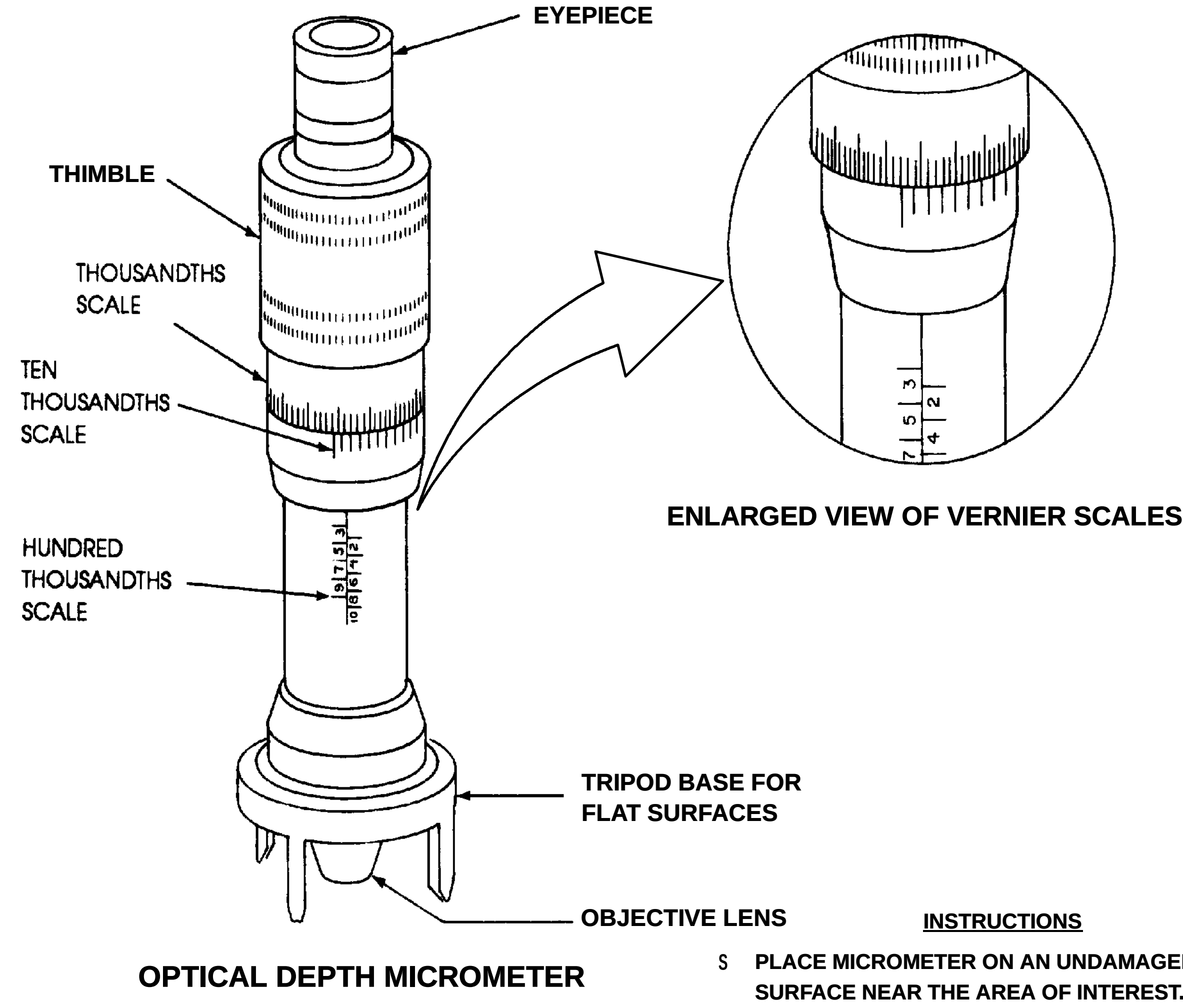
NOTE

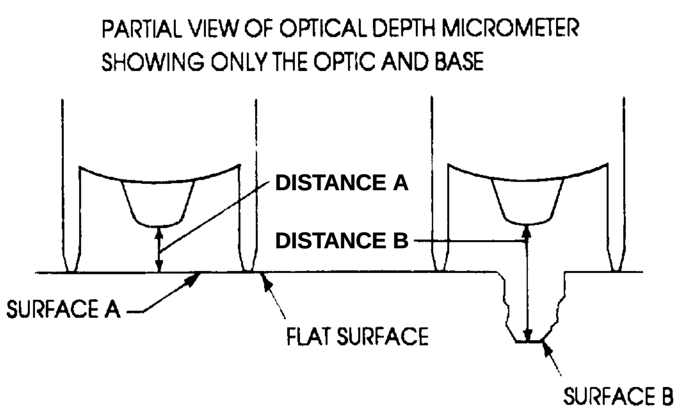
The following inspection methods are to be accomplished only by NDI qualified and certified personnel. Refer to NAVAIR 01–1A–16, T.O. 33B–1–1, TM 55–1500–335–232 or specific NDI manual for more detailed inspection procedures.

4–2.5. Fluorescent penetrant inspection. In fluorescent penetrant inspections, the component is cleaned and then treated with a fluorescent penetrating liquid which is capable of entering surface cracks or flaws. After removing the penetrant from the surface, a developer (powder or liquid suspension of powder) is applied to absorb penetrant trapped in cracks. Under ultraviolet light, the absorbed penetrant is visible directly above the cracks from which it was drawn. The penetrant inspection method is used to detect stress corrosion cracking, special cases of intergranular corrosion, and residual corrosion following grinding. Intergranular corrosion attacks the metallic grain boundaries and forms a network of very fine cracks. In the early stages, the crack indications are visible only under 10X or greater magnification. Penetrant indications of intergranular corrosion appear as a residual background and are resolved only under magnification. Developer is not used when evaluating a penetrant indication using a magnifying glass. In addition, penetrant inspection is often used to monitor the surface for adequacy of corrosion removal by grinding. Caution must be exercised because mechanical removal methods cause smearing which may obscure indications of remaining corrosion attack. In monitoring corrosion grind–out areas, a developer is not used and following removal of excess surface penetrant, the area is examined using a low power magnifying glass (10X). The examination should be repeated after a minimum five minute dwell. When corrosion is no longer detected, the inspection process shall be repeated using non–aqueous developer.

4–2.5.1. Limitations.

4–2.5.1.1. Flaw location. Penetrant inspection is applicable to all solid, nonporous materials provided that the flaw is open to the surface of the part. To detect subsurface flaws, another inspection method must be used.





INSTRUCTIONS

- PLACE MICROMETER ON AN UNDAMAGED SURFACE NEAR THE AREA OF INTEREST.

NOTE

FOR BEST RESULTS, THE MICROMETER TRIPOD SHOULD BE STABLE AND REMAIN STATIONARY WHEN MEASURING DISTANCES.

- FOCUS ON UNDAMAGED SURFACE BY ADJUSTING THE THIMBLE ON THE MICROMETER.
- TAKE READING FROM VERNIER SCALES. THIS READING IS DISTANCE A.
- MOVE MICROMETER AND CENTER OVER CORROSION PIT.
- FOCUS ON BOTTOM OF PIT BY ADJUSTING THE THIMBLE ON THE MICROMETER.
- TAKE READING FROM VERNIER SCALES. THIS READING IS DISTANCE B.
- PIT DEPTH = DISTANCE B - DISTANCE A

Figure 4-3. Optical Depth Micrometer

4–2.5.1.2. Restricted flaw openings. The penetrant inspection process depends upon the ability of the penetrant to enter and exit the flaw opening. Any factor that interferes with the entry or exit reduces the effectiveness of the inspection. Organic surface coatings, such as paint, oil, grease, resin, are examples. Any coating that covers or bridges the flaw opening will prevent penetrant entry. Even when the coating does not cover the opening, the material at the edge of the opening affects the mechanism of penetrant entry and exit and greatly reduces the reliability of the inspection. Coatings at the edge of the flaw may also retain penetrant causing background fluorescence. An inspection method other than penetrant must be used if the organic coating cannot be stripped or removed from the surface to be inspected.

4–2.5.1.3. Smeared metal. Mechanical operations, such as shot peening, machine honing, abrasive blasting, buffing, wire brushing, grinding, or sanding, will smear or peen the surface of metals. This mechanical working closes or reduces the surface opening of any existing discontinuities. Mechanical working (smearing or peening) also occurs during service use when parts contact or rub against each other. Penetrant inspection will not reliably indicate discontinuities when it is performed after a mechanical operation or service use that smears or peens the surface. Chemical etching prior to penetrant operations is recommended to improve test sensitivity when smeared metal is present.

4–2.5.1.4. Porous surfaces. Penetrant inspection is impractical on porous materials with interconnected subsurface porosity. The penetrant rapidly enters the pores and migrates through the network. This results in an overall fluorescence or color that would mask any potential discontinuity indications. In addition, removal of the penetrant may not be possible after the inspection.

4–2.6. Eddy current inspection. The eddy current inspection method may be used to detect or evaluate accessible and inaccessible surfaces for corrosion. This method can detect and evaluate uniform surface pitting, intergranular, exfoliation, and stress corrosion. Detection of corrosion with eddy current techniques is used on aircraft skins where corrosion may occur on inaccessible interior surfaces. Corrosion usually occurs in areas where moisture is entrapped. If relatively uniform thinning is expected, corrosion detection may be simply a matter of thickness measurement. In most instances, corrosion is confined to smaller localized areas of relatively small diameter. As skin thicknesses increase, sensitivity to small areas and shallow depths of corrosion is reduced. Corrosion on either member of faying surfaces may be detected. Refer to NAVAIR 01–1A–16, T.O. 33B–1–1, TM 55–1500–335–23, or specific NDI manuals for more detailed inspection procedures. Eddy current can also be used for corrosion removal inspections, but is less sensitive than penetrant.

4–2.7. Ultrasonic inspection. The ultrasonic inspection method may be used to detect exfoliation, intergranular, uniform surface, and stress corrosion. Ultrasonic thickness gaging is included in this method. Ultrasonic inspection for farside pitting and internal exfoliation corrosion may be accomplished using shear (“S”) wave and longitudinal (“L”) wave techniques. The use of a delay line transducer is recommended for “L” wave inspection. The delay will improve resolution of both near and far surface corrosion. Technique development is required for specific applications. Refer to NAVAIR 01–1A–16, T.O. 33B–1–1, TM 55–1500–335–23, or specific NDI manuals for more detailed inspection procedures.

4–2.8. Radiographic inspection. Although the radiographic inspection method is available for detection and evaluation of corrosion, it is generally used only when no other method can accomplish the inspection. The manhour requirements are high for on–aircraft radiography. Radiographic inspection is used in combination with ultrasonics to determine the condition of aluminum honeycomb. Refer to NAVAIR 01–1A–16, T.O. 33B–1–1, TM 55–1500–335–23, or specific NDI manuals for more detailed inspection procedures.

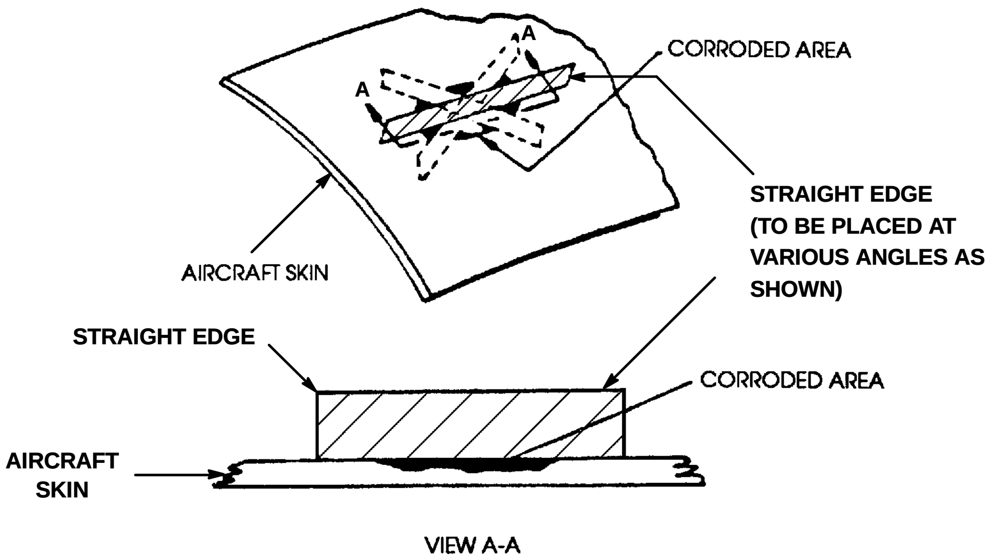


Figure 4–4. Typical Usage of Straight Edge in Determining if Suspect Areas Have Been Previously Reworked

4–3. EVALUATION OF CORROSION DAMAGE. Visually determine if corrosion is in an area which has previously been reworked. If the corrosion damage is located in an area that has been previously ground out, measure the damage to include the material which has previously been removed. A straight edge and a 10X magnifying glass may be used to assist in determining if an area has previously been reworked. Place the straight edge across the area being examined at various angles and check for irregularities, low spots, or depressions (Figure 4–4). If any irregularities, low spots, or depressions are found, and a visual determination cannot verify previous rework, closely examine the suspected area and the surrounding area using a 10X magnifier. After determining that the area has been previously reworked, evaluate the depth of the previous rework (grind–out) to determine if further metal removal will exceed grind–out limits specified in the applicable aircraft manuals or as specified in paragraph 5–6. Depth measurements can also be made using the depth gage as described in paragraph 4–2.2.

4–4. DEGREES OF CORROSION. Corrosion must be evaluated after the initial inspection and cleaning to determine the nature and extent of repair or rework needed. It is difficult to draw a distinct and specific dividing line among the degrees of corrosion. Consequently, the first requirement for a reliable evaluation is sound maintenance judgment. Use the following categories in reporting degrees of corrosion.

4–4.1. Light corrosion. At this degree, the protective coating is scarred or etched and the condition of the metal is characterized by discoloration and pitting to a depth of approximately one mil (0.001 inch) maximum. This type of damage can normally be removed by light hand sanding.

4–4.2. Moderate corrosion. This looks like corrosion except that there may be some blisters or evidence of scaling and flaking of the coating or paint system, and the pitting depths may be as deep as 10 mils (0.010 inch). This type of damage is normally removed by extensive hand sanding or light mechanical sanding.

4–4.3. Severe corrosion. Its general appearance may be similar to moderate corrosion with severe intergranular corrosion, blistering exfoliation, scaling, or flaking. The pitting depths are deeper than 10 mils (0.010 inch). This damage must be removed by extensive mechanical sanding or grinding.

CHAPTER 4

INSPECTION AND CORROSION PRONE AREAS

SECTION II. CORROSION PRONE AREAS

4–5. COMMON AREAS. There are certain corrosion prone areas common to all aircraft (see Figures 4–5 through 4–24). Corrosion prone areas should be cleaned, inspected, and treated more frequently than less corrosion prone areas. The following paragraphs describe the areas and contain illustrations to aid in inspections. However, the list is not complete and should be expanded by referencing the maintenance manuals and maintenance cards for each specific aircraft, which will show other possible trouble spots. Updated charts may be obtained from the applicable cognizant activity.

4–5.1. Fasteners. There are thousands of fasteners on aircraft exterior surfaces, and areas around these fasteners are trouble spots (see Figures 4–5 and 4–6). These areas are subject to high operational loads, moisture intrusion, and susceptibility of the skin material to corrosion. The high strains cause the paint to crack around the fasteners, which provides a path for corrosive materials. All paints will crack to some degree around fasteners.

4–5.2. Faying surfaces and crevices. Similar to corrosion around fasteners, corrosion in faying surfaces, seams, and joints is caused by the intrusion of salt water and other corrosive agents. Entry of fluids by capillary action causes corrosive liquids to flow into the tightest of joints. The effect of this type of corrosion resulting from fluid intrusion is usually detectable by bulging of the skin surface.

4–5.3. Spot–welded assemblies. Spot–welded assemblies are particularly corrosion prone. As shown in Figures 4–7 and 4–8, corrosion is the result of the entrapment of corrosive agents between the parts of the assemblies. Corrosive attack causes skin buckling or spotweld bulging (Figure

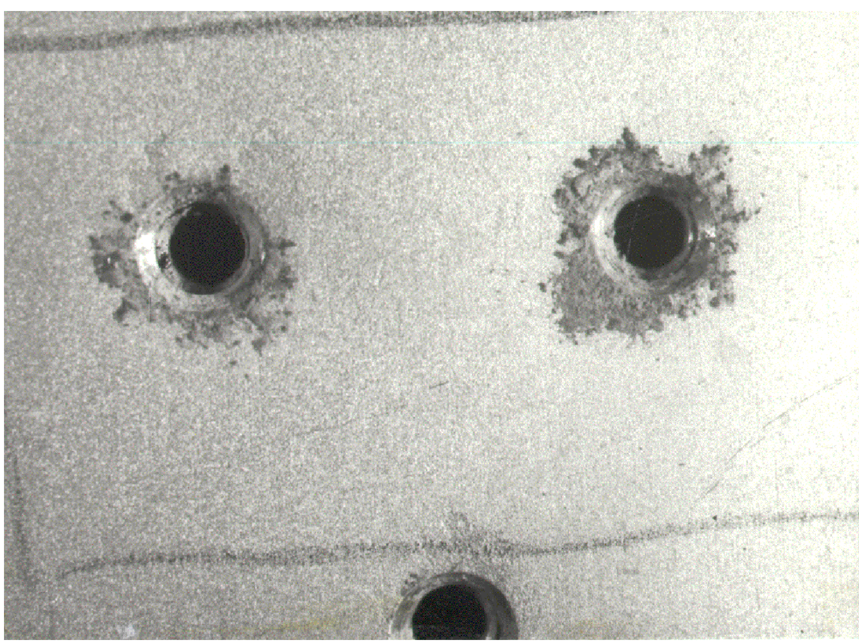


Figure 4–5. Corrosion Around Fasteners

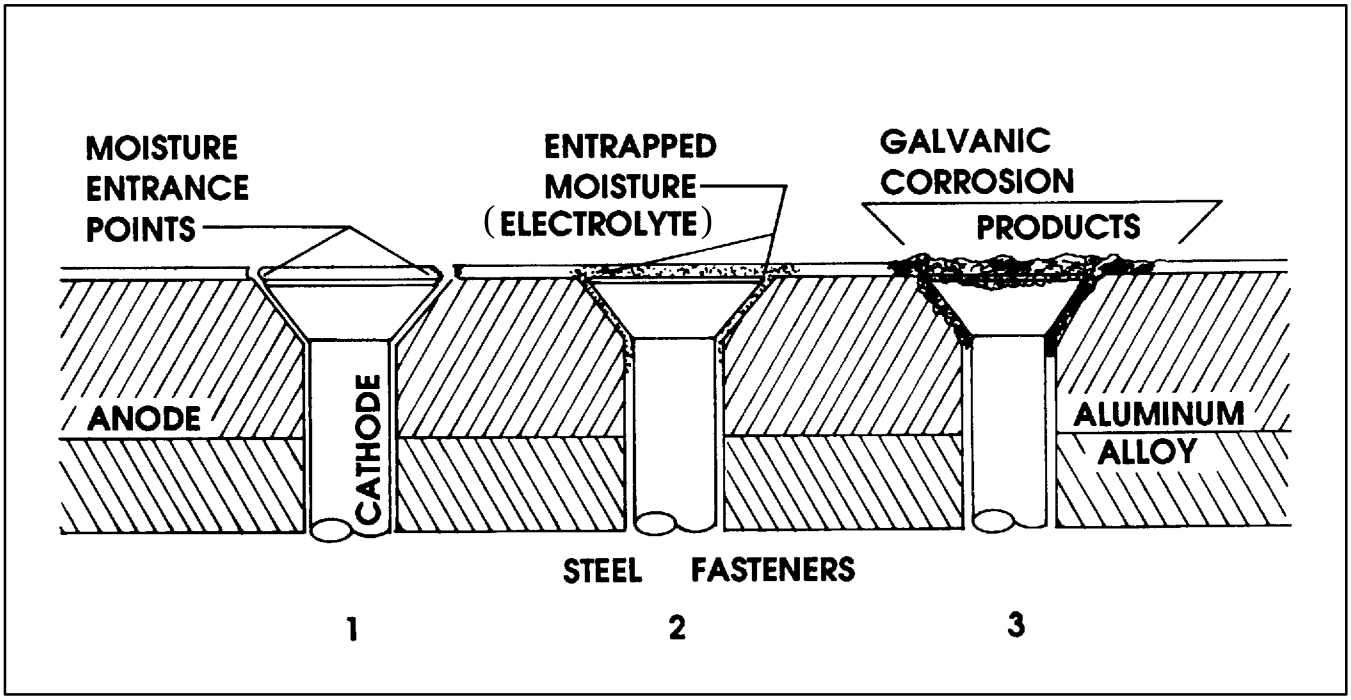


Figure 4-6. Galvanic Corrosion of Aluminum Adjacent to Steel Fasteners

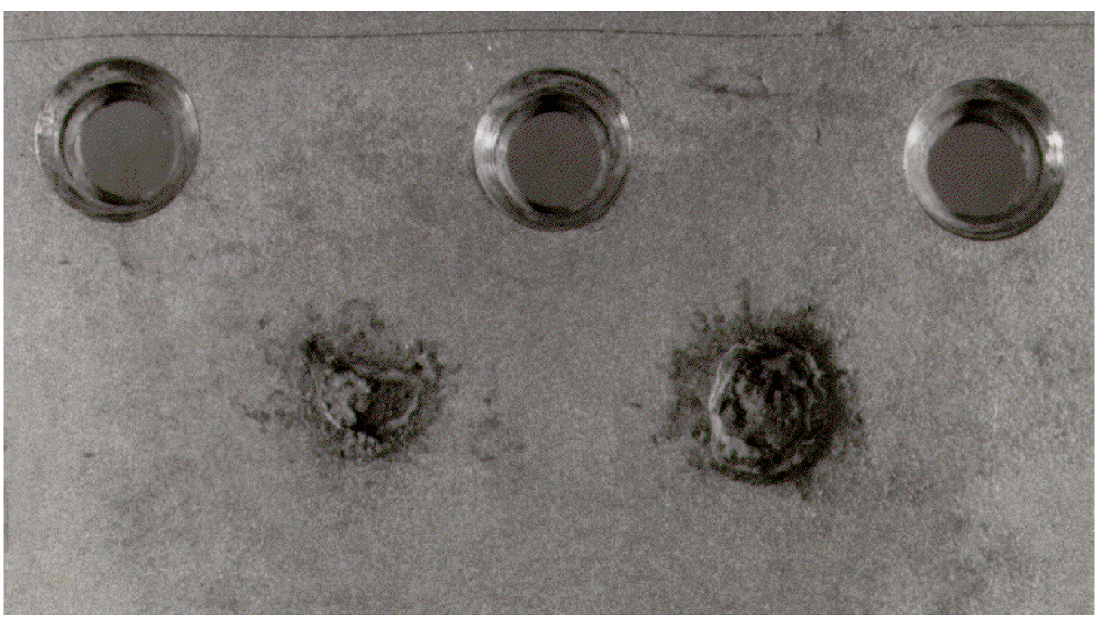


Figure 4-7. Spot Weld Corrosion

4–8) and eventual spotweld fracture. Skin and spot–weld bulging in their early stages may be detected by sighting or feeling along spot–welded seams. The only way to prevent this condition is by keeping the potential moisture entry points, including gaps, seams, and holes created by broken spot–welds, filled with a sealant or suitable preservative compound.

4–5.4. Exhaust impingement areas. Exhaust impingement areas include areas exposed to engine, rocket, and missile exhausts, gun blast, or any other surface that is exposed to exhaust gases of installed equipment. Exhaust gases cover the surface finish with deposits (i.e., corrosive ash and residual solids) and damage the finish. Surfaces located in the path of rocket and gun blasts, including gun compartment systems and spent ammunition collection chutes, are particularly susceptible to deterioration and corrosion (Figure 4-9). In addition to the corrosive effect of the gases and exhaust deposits, the protective finish is often blistered by the heat, blasted away by the high velocity gases, or abraded by spent shell casings or solid particles from gun and rocket exhausts (Figure 4–10). These areas require more attention during inspections.

4–5.5. Wheel wells and landing gears. Wheel well areas probably receive more abuse than any other area on the aircraft. They are exposed to mud, salt, gravel, and other flying debris from runways during taxiing, takeoff, and landing, and they are exposed to salt water and spray when aircraft are parked aboard ship. Because of the many complicated shapes, assemblies, and fittings in the area, complete coverage with protective coatings is difficult to maintain (see Figure 4–11).

4–5.6. Flap and slat recesses. Flap and slat recesses (Figure 4–12) and equipment installed in these areas, which are normally closed, may corrode unnoticed unless special inspections are performed.

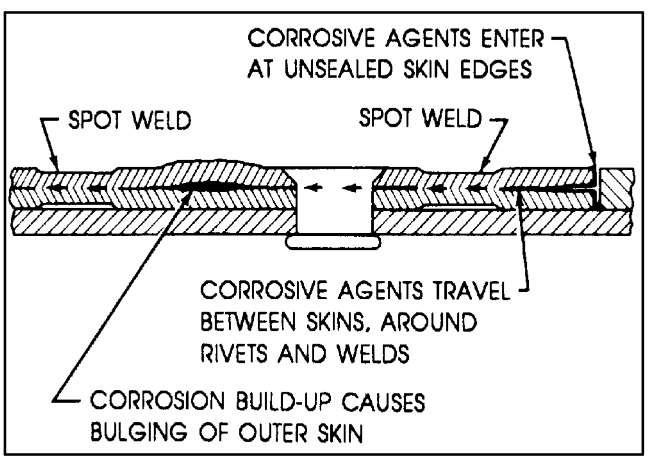


Figure 4–8. Spot Welded Skin Corrosion Mechanism

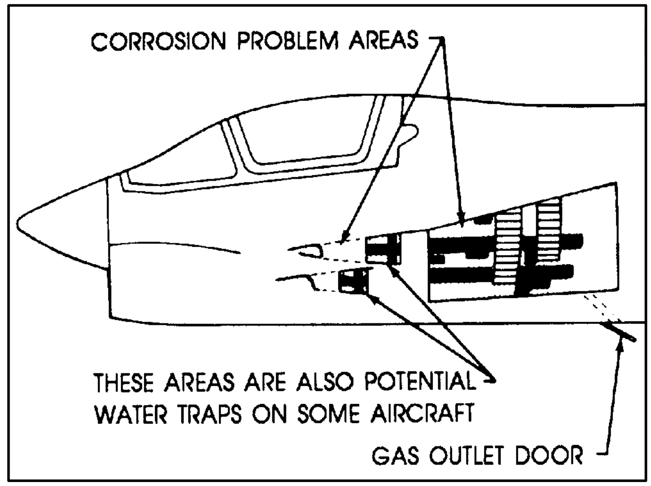


Figure 4–9. Gun Blast Area Corrosion Points

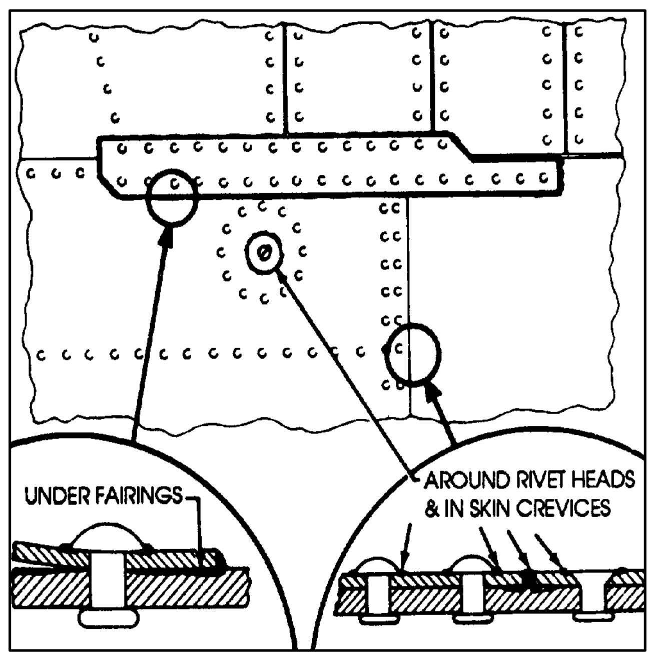


Figure 4–10. Exhaust Trail Area Corrosion Points

4-5.7. Engine frontal areas and air inlet ducts. Since these areas are constantly abraded by dirt, dust, and gravel, and eroded by rain, special attention shall be given to:

a. Engine frontal areas (see Figures 4-13 and 4-14).

b. Leading edges of air inlet ducts, including hardware inside ducts (see Figures 4-15 and 4-16).

c. Due to heat dissipation requirements, oil cooler cores and reciprocating engine cylinder fins are not usually painted. Engine accessory mounting bases may have small, unpainted areas on the machined mounting surfaces. With moist, salt-laden air flowing over these surfaces, they are vulnerable to corrosion.

Figure 4-11. P-3 Nose Landing Gear Wheel Well

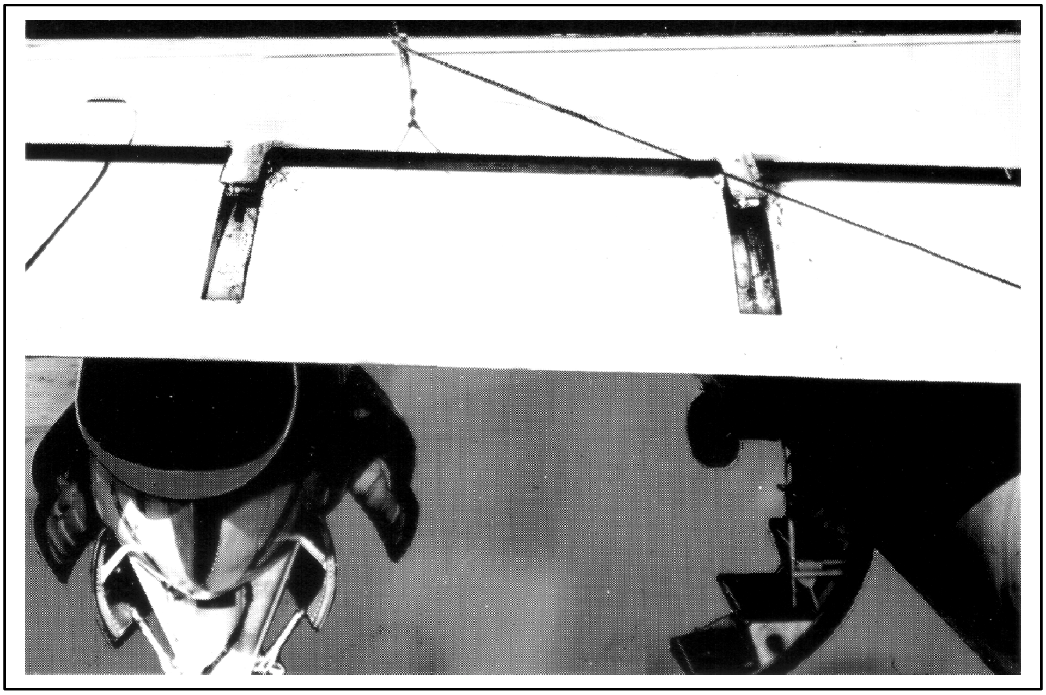


Figure 4-12. Flaps Lowered to Expose Recess Areas

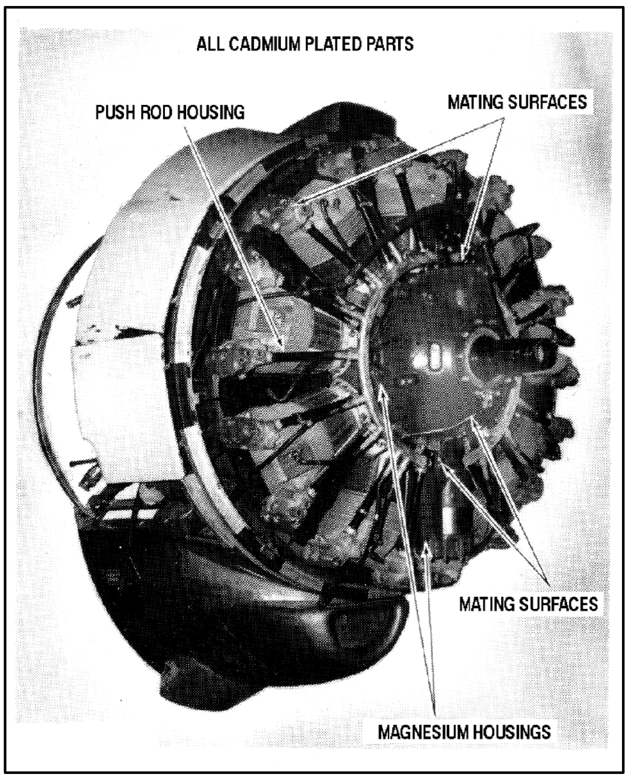


Figure 4-13. Reciprocating Engine Frontal Area Corrosion Points

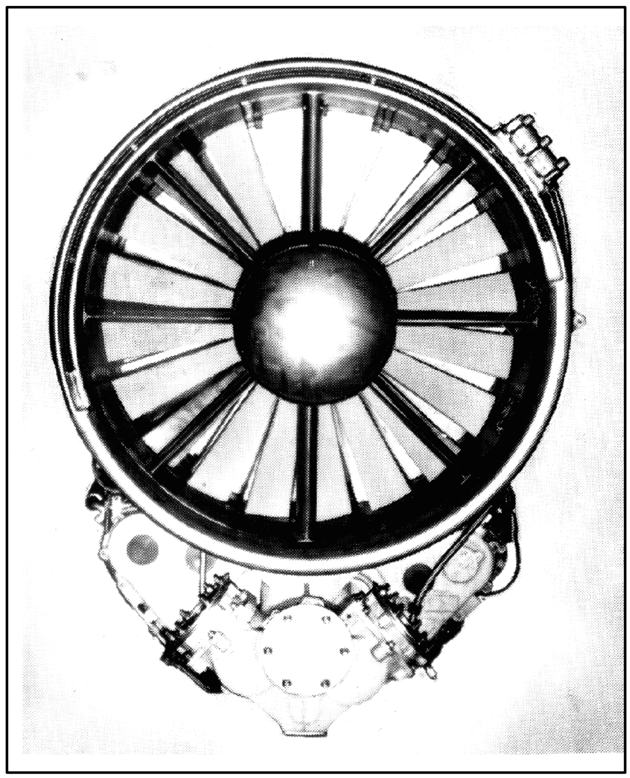


Figure 4-14. Jet Engine Frontal Area Corrosion Points

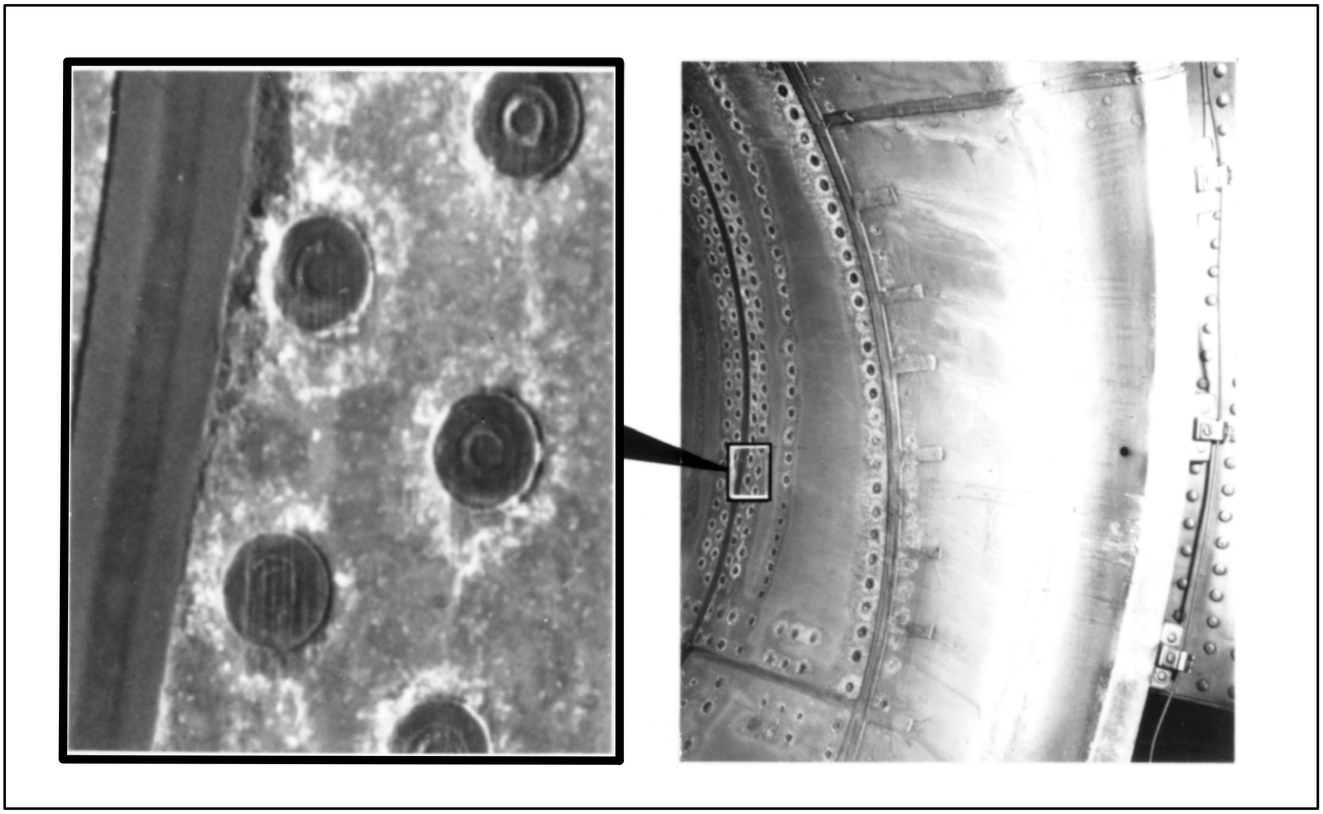


Figure 4-15. Corrosion in Air Intake Duct

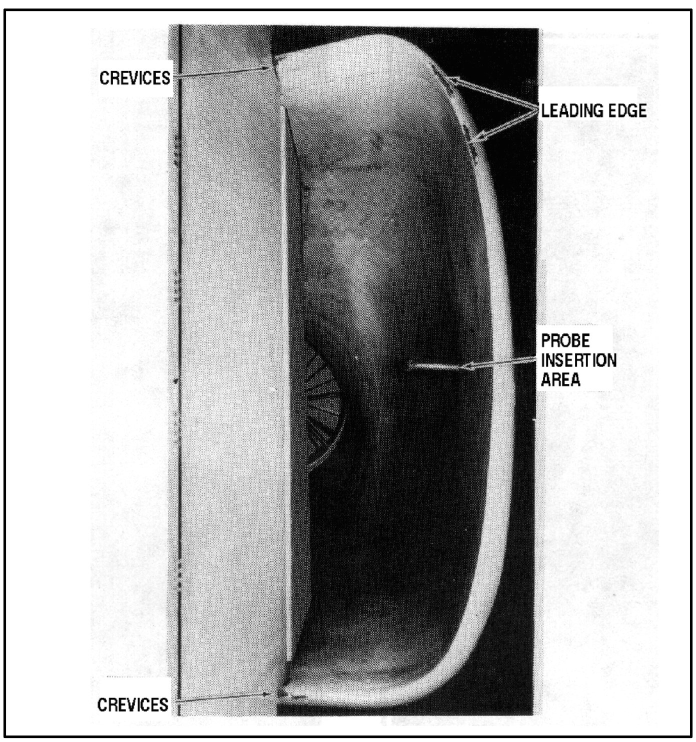


Figure 4-16. Corrosion Prone Point of Air Inlet

4–5.8. Wing–fold joints and leading edges of wings and control surfaces.

a. Because wing and fin–fold areas are vulnerable to corrosive attack when the wings are folded, they require special attention (see Figure 4–17).

b. Both leading edges of wings and control surfaces are constantly exposed to salt laden air, thus special attention should be given to these areas which are vulnerable to corrosion.

4–5.9. Hinges. Figures 4–18 and 4–19 are highly susceptible to corrosion because of dissimilar metal contact that results from wear and damage of protective metallic coatings. They are natural traps for dirt, salt, and moisture. Piano hinges, which are extensively used, are especially vulnerable to attack.

4–5.10. Control cables. Control cables present a corrosion problem whether they are made of carbon steel or stainless steel. As shown in Figure 4–20, the presence of bare spots in the protective coating is one of the main contributing factors to the corrosion of cables. Dirt, dust, and grime that collect will lead to corrosion and cable failure.

4–5.11. Relief tube outlets. Human waste products are very corrosive (Figure 4–21). These areas should be cleaned frequently and the paint finish kept in good condition. The relief tubes are usually made of plastic and should not present a corrosion problem.

4–5.12. Water entrapment areas. Figure 4–22 shows common water entrapment areas. Design specifications require that aircraft have drains installed in all areas where water may collect. However, in many cases, these drains are ineffective either because of improper location or because they are plugged by sealants, fasteners, dirt, grease, and debris. The plugging of a single drain hole or the altering of the attitude of the aircraft can cause a serious structural defect if salt water or other corrosives remain for any appreciable length of time in one of these entrapment areas. Daily inspection and cleaning of lowpoint drains is a standard Navy requirement. These areas may accumulate water following washing or rinsing of aircraft. Where this is a recurring problem, procedures shall be developed to prevent water accumulation. Drain holes shall not be drilled by Organizational/Unit or Intermediate levels unless authorized by the parent service organization.

4–5.13. Bilge areas. These areas are natural collection points (i.e., lower point/areas of aircraft section) for water, salt water, dirt, loose fasteners, drill shavings, and other debris (Figure 4–23). Keeping bilge areas free of debris and fluids and application of recommended corrosion preventive compounds (CPCs) are the best protection against corrosion.

4–5.14. Battery compartments and battery vent openings. In spite of protective paint systems, corrosion preventive compounds, and venting provisions, battery compartments are high corrosion problem areas (Figure 4–24). Fumes from overheated battery electrolyte will spread to adjacent internal cavities causing rapid corrosion of unprotected surfaces. If the battery installation has an external vent opening on aircraft skins, include this area in battery compartment inspection and maintenance procedures. Frequent cleaning and neutralization of deposits will minimize corrosion. Leakage of aircraft batteries with electrolytes of either sulfuric acid or potassium hydroxide will cause corrosion. Consult the applicable maintenance manuals of the particular aircraft to determine which type of battery is used. Refer to Chapters 3, 8 and specific aircraft maintenance instruction manuals for instructions on neutralizing battery electrolytes.

4–5.15. Magnesium Parts. Magnesium parts are extremely corrosion prone. Special attention must be given to proper treatment of their surfaces, insulation, and paint coatings.

4–5.16. Electrical connectors and other components. Some electrical connectors are potted with a sealant compound to prevent the entrance of water into the areas of connectors where wires are attached to pins. Rubber O–rings are also used to seal moisture out of the mating area of pin connections. Moisture will get into electrical plugs and cause failure. It is necessary that such plugs be disconnected periodically for inspection and corrosion treatment. The use of unauthorized sealants or potting materials can cause severe damage to affected connectors or components. Refer to NAVAIR 16–1–540, T.O. 1–1–689, or TM 55–1500–343–23 for authorized avionic materials and procedures.

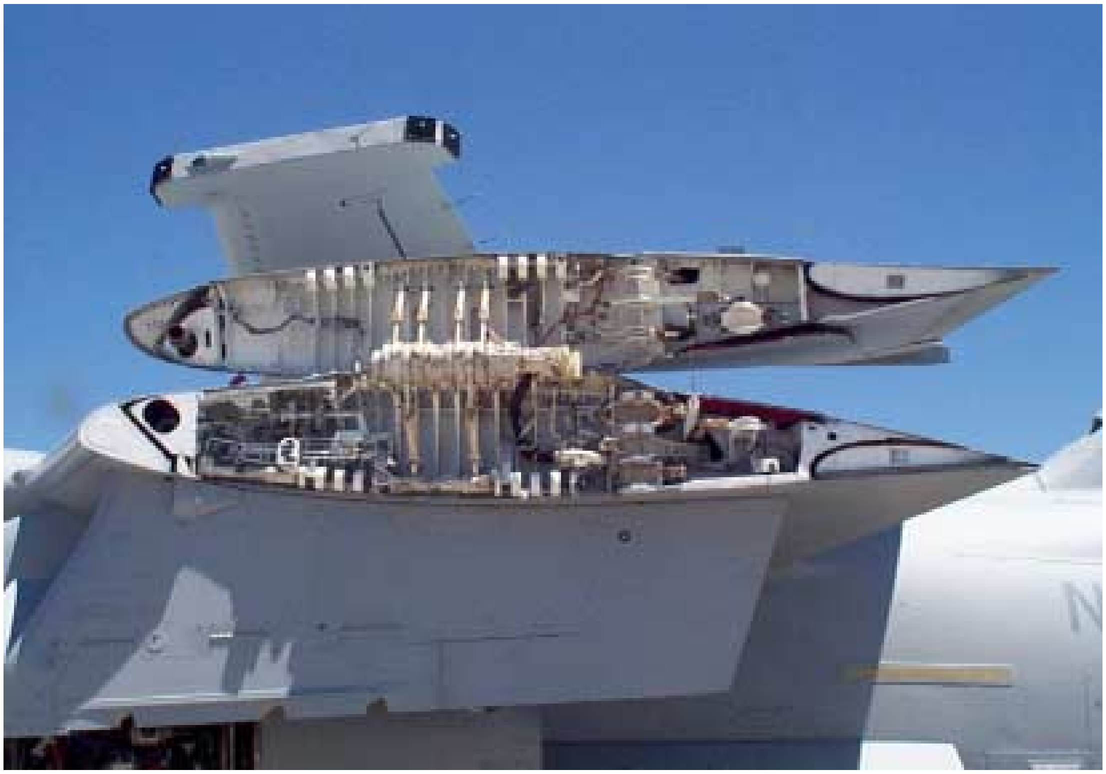


Figure 4-17. Wing Fold Joint

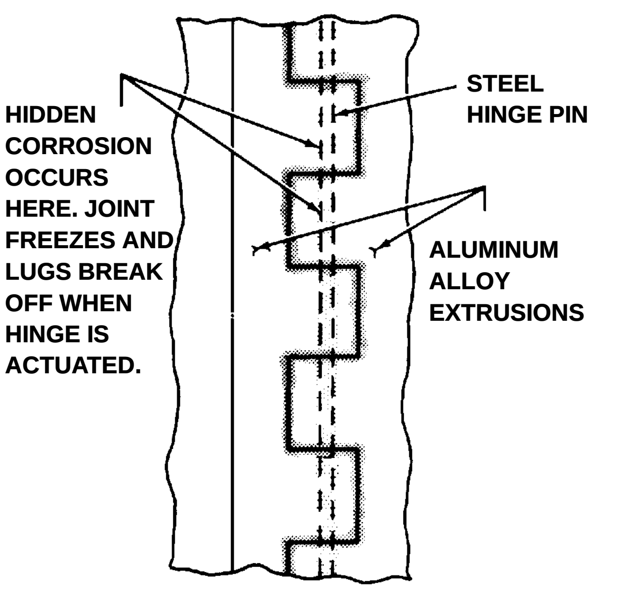


Figure 4-18. Hinge Corrosion Points

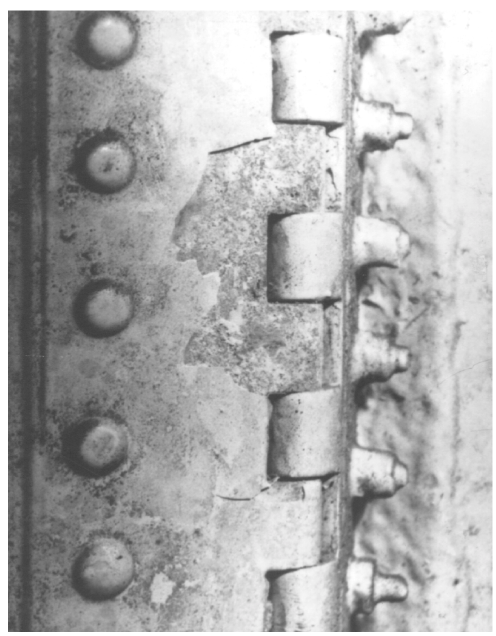


Figure 4-19. Piano Hinge Lugs

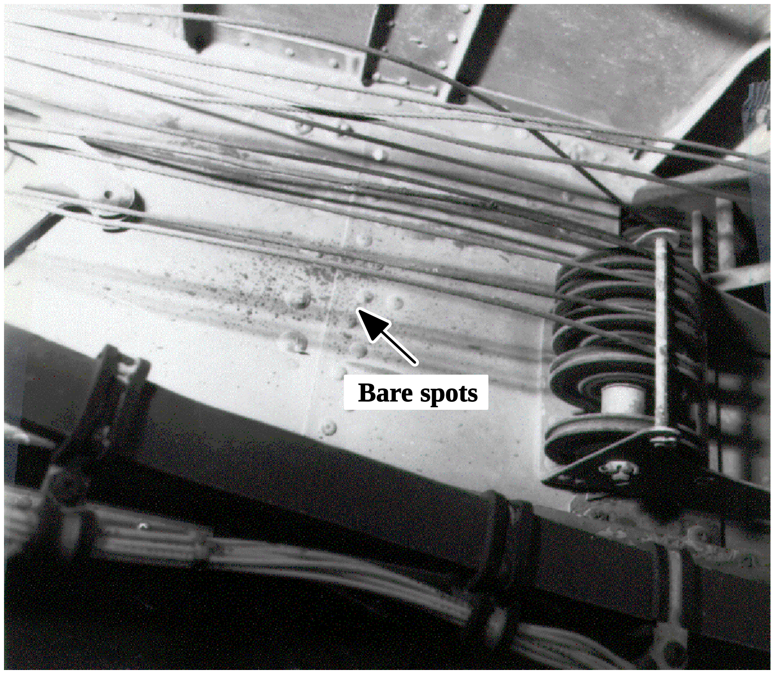


Figure 4–20. Control Cables

Figure 4–21. Typical Corrosion Around a Personnel Relief Tube Vent

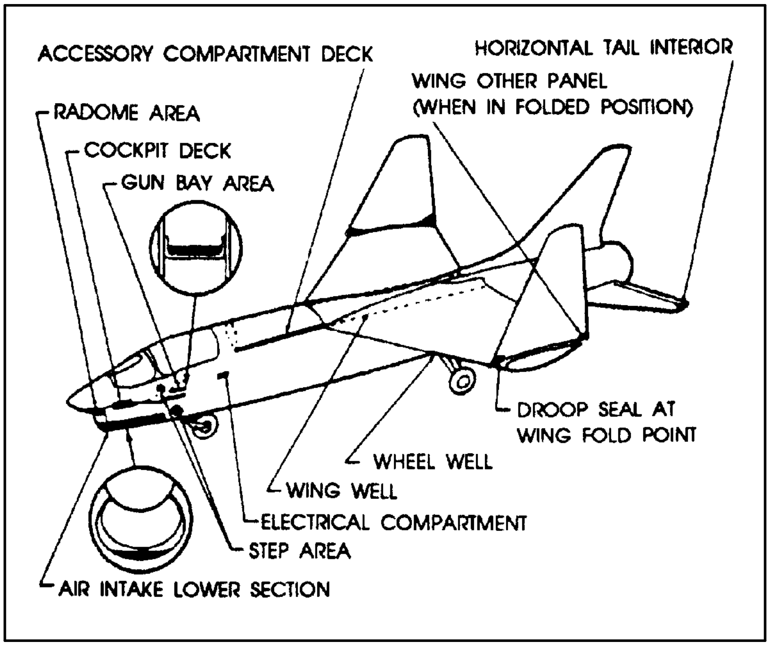


Figure 4-22. Common Water Entrapment Areas

Figure 4-23. Bilge Areas

Figure 4-24. Battery Compartment

CHAPTER 5

CORROSION REMOVAL AND SURFACE TREATMENT

SECTION I. CORROSION REMOVAL

5–1. PURPOSE. This chapter covers instructions for paint and corrosion removal and surface treatment. When corrosion is detected, a specific and immediate program for corrective treatment is required. Each type of corrosion has its own peculiarities and will require special treatment. Complete treatment involves thorough inspection of all corroded areas and evaluation of the corrosion damage (Chapter 4), paint and corrosion removal, application of chemical surface treatments (Chapter 5), sealing (Chapter 6), and application of paint finishes (Navy: Chapter 7, Air Force: T.O. 1–1–8, Army: TM 55–1500–345–23). Chemical corrosion removal techniques are not authorized for Navy organizational or intermediate level maintenance. For additional procedures specific to Army and Air Force maintenance, see Appendices D and E respectively.

5–2. RESPONSIBILITY

CAUTION

Propellers and helicopter blades have critical balance requirements. Refer to the appropriate propeller or blade manual for evaluation and repair limits of corrosion, erosion, and abrasion damage.

5–2.1. Personnel assigned to corrective maintenance tasks must be specially trained in the use of chemical paint remover, abrasive materials, powered tools, and damage limits. Inadequate training will lead to further damage of equipment and poses a safety hazard to the individual.

5–3. CORRECTIVE ACTION. Corrective maintenance depends on: (1) the type of surface involved (metallic or composite); (2) the area of the damaged surface (small corrosion spot or large heavily corroded area); and (3) the degree of corrosion, as determined in Chapter 4. Composite materials, such as fiberglass or graphite–reinforced structures, shall not be exposed to chemical paint remover, but shall only be scuff sanded to the primer coat. Since composite materials do not corrode, corrosion removal techniques are not applicable and shall not be used. Corrosion shall always be removed by the mildest effective technique. For procedures specific to the various alloys, see Tables 5–5, 5–4, and 5–1.

5–4. PAINT REMOVAL. (For Air Force procedures, refer to T.O. 1–1–8.)

CAUTION

Abrasive blasting using glass beads or aluminum oxide shall not be used for removing paint. Glass bead and aluminum oxide blasting may be damaging to the underlying metal. Abrasive wheels other than flap brushes, specified in this manual, shall not be used for removing paint.

5–4.1. <u>Composite surfaces.</u>

5–4.1.1. <u>General removal.</u> Paint shall be removed from composites, such as fiberglass, carbon/graphite, and kevlar using only mechanical removal techniques as specified in paragraph 5–4.1.2, unless specific exceptions are provided in the appropriate maintenance manuals. Due to the irregularities in composite surfaces, complete removal of the paint can damage fibers in the surface layers. Therefore, paint removal by scuff sanding shall not go beyond the primer coat.

5–4.1.2. <u>Repair.</u> Paint removed from composite surfaces for the purposes of performing repairs shall be performed by hand sanding or by using an orbital sander per NAVAIR 01–1A–21. The use of other types of powered sanders is prohibited due to the high potential for causing laminate damage. Paint system removal (to include removal of the majority of the primer) is required to prevent the compromising of the adhesive bond. Use extreme care during topcoat and primer removal to prevent sanding into the laminate.

5–4.2. <u>Metallic surfaces.</u> For areas of several square inches, paint may be removed using abrasive mats or flap brushes, as in paragraph 5–4.3.1, taking care not to remove underlying metal. Chemical paint removal, as specified in paragraph 5–4.4, may be used for areas larger than several square inches. Plastic media blasting, as specified in paragraph 5–4.3.2, may be used at intermediate maintenance activities and depots to remove paint.

5–4.3. Mechanical paint removal.

WARNING

Paints may contain toxic materials such as chromates, barium, strontium, or lead. Use goggles, gloves, and cartridge respirator during scuff sanding or flap brush operations. Hearing protection and air respirator shall be worn during plastic media blasting operations. Unprotected personnel shall not come in contact with dust. Contact the local safety and health office for proper personal protection equipment (PPE).

5–4.3.1. Abrasive mats and flap brushes.

CAUTION

Consult weapon system specific manuals for corrosion limit removal.

Medium grade (Grade C) abrasive mats (A–A–58054) shall be used without powered tools for scuff sanding of painted composite surfaces. Under no circumstances shall the primer be removed to expose the composite material beneath. Damage to surface fibers always occurs when primer is completely removed. The abrasive mat can be wet with fresh water or diluted cleaning compound (MIL–PRF–85570) to prevent clogging the pad. Fine (Grade B) or very fine (Grade A) abrasive mats on an orbital sander or fine or very fine flap brushes on a pneumatic drill may be used for power tool scuff sanding of painted metallic surfaces. Corrosion occurring on installed fasteners shall be removed using dry honing machine (i.e., vacu–blaster) or hand held abrasive materials.

5–4.3.2. Plastic media blasting (PMB). PMB is an abrasive blasting method used to remove paint coatings on aluminum. PMB is a quick and environmentally preferred alternative to most types of chemical paint removers, but it can cause damage to underlying metal and injury to personnel if not performed by trained operators using approved methods.

5–4.3.2.1. PMB restrictions. The following restrictions apply to PMB operations:

a. PMB of aircraft component surfaces is authorized for use ONLY at Intermediate and higher (e.g. Depot) maintenance activities upon completion of specialized operator training. PMB is NOT authorized at Organizational level maintenance activities. PMB operators shall receive approved and documented training as specified in the Catalog of Navy Training Courses (CANTRAC).

b. No PMB in a walk–in booth (open blasting) shall be performed at the Organizational and Intermediate level maintenance activities. At the Intermediate level, only the PMB of aircraft component surfaces in a blast cabinet (glove box) designed for plastic media is authorized.

c. Training for PMB operators shall include lectures and demonstrations on equipment operation and maintenance, masking and blasting techniques, process parameters, damage recognition, media contamination prevention and removal, and safety requirements.

d. PMB of aircraft component surfaces at Intermediate maintenance level activities is restricted to metallic surfaces 0.032 inch thick or greater. Nonmetal surfaces, such as composites or fiberglass, and metal bonded structures are not authorized for PMB.

e. Corroded steel components shall not be processed in equipment used for aluminum and magnesium components without first removing all corrosion products (rust). Plastic media used to remove paint from rusted steel parts should be completely purged from blasting equipment, and the equipment should be thoroughly cleaned prior to blasting aluminum or magnesium parts. Best practice is to maintain and use separate equipment for steel components.

f. Plastic media used to remove non–slip, walkway coatings (such as A–A–59166), will become contaminated and the media must be replaced prior to blasting aluminum or magnesium parts.

5–4.3.2.2. Fluorescent penetrant inspection limitations. Because PMB can peen or smear soft metals, it shall not be used to remove paint from aluminum or magnesium components requiring subsequent fluorescent penetrant inspection (per NAVAIR 01–1A–16) unless specifically directed by the engineering authority for that component. Distortion caused by PMB can limit crack detection. PMB is permitted prior to eddy current inspection. Chemical etching may be used to reopen cracks after PMB by removing distorted metal, however, this process shall be performed only in accordance with specific engineering authority, approval, and written detailed process and application instructions. Chemical etching also removes protective coatings such as anodize and chromate conversion coatings. Instructions for reapplication of these protective coatings must also be provided by the engineering authority.

5–4.3.2.3. Operator safety. Operational safety compliance shall be in accordance with local regulations and the following:

a. PMB creates airborne particles which may be hazardous if inhaled or allowed to contact eyes or skin. Both eye protection (goggles) and respirator are required for all operating personnel. Do not allow unprotected personnel to come in contact with dust. Wash hands thoroughly before eating or smoking.

b. PMB process is noisy; typically greater than 80 decibels. Hearing protection is mandatory.

c. All blasting equipment and components being blasted shall be properly grounded to dissipate static electricity.

5–4.3.2.4. PMB equipment. The blast cabinet (glove box) shall be specifically designed for use with plastic media meeting the requirements of NA 17–600–191–6–2 (see Table 1–2). Open blasting equipment (i.e., walk–in booth) is not authorized for use on aircraft surfaces at both organizational and intermediate level maintenance activities. The blast cabinet shall be at the pressure pot capable of maintaining constant blast pressure and media flow using a 1/4 inch to 3/8 inch I.D. nozzle. The blast cabinet shall be equipped with an air pressure regulator and pressure gage to provide easy adjustment. The equipment shall allow for several successive cycles and shall be equipped with a dust collection system to remove dust particles (recommend 60 mesh or finer). The dust collection system shall be accessible for removal of the collected dust to facilitate proper waste disposal. A magnetic particle separator shall be an integral part of the system to remove ferrous particles from recirculated media.

5–4.3.2.5. Preparation prior to PMB. Prior to PMB, all components to be blasted shall be thoroughly cleaned to remove dirt, oil, grease, and other soils. If not removed, these soils will contaminate the plastic media, causing possible damage to the surface(s) being blasted and lead to malfunctioning of the blasting equipment. Refer to Chapter 3 for cleaning methods and materials. Allow the surfaces to dry completely prior to blasting. Surfaces or areas which are sensitive to contamination or impact damage from PMB shall be masked or covered to prevent damage. These surfaces include precision bearings and gears, grease fittings, fuel, oil, and hydraulic lines, tanks, pumps, passages, and actuators, nonmetal surfaces (i.e., glass, plastic, fiberglass, etc.), electrical wiring and connectors, and avionics components. Masking may be accomplished using one or more of the following materials:

CAUTION

Hydraulic and fuel system equipment shall be protected from contamination as specified in Section VI of NAVAIR 01–1A–20.

a. Plastic, rubber, or metal plugs and caps.

b. Aluminum or paper backed masking tapes, kraft paper, and plastic sheeting (see Appendix A). These materials are not resistant to direct impact by PMB.

c. Impact resistant tape (3M No. 500). See Appendix A.

5–4.3.2.6. PMB procedures. To prevent surface damage during blasting, the blast nozzle shall be kept moving at all times in a sweeping motion and shall not be allowed to dwell in one place. Do not continue blasting if any surface damage is suspected. The following parameters shall be adhered to in the operation of PMB cabinets:

a. Plastic bead media shall conform to MIL–P–85891, Type V (acrylic), size 20–30 mesh material (Appendix A).

b. Blasting pressure shall be no higher than 50 psi output pressure, which corresponds to approximately 40 psi at the blast nozzle.

c. Distance from nozzle tip to surface being blasted shall be no less than 12 inches.

CAUTION

Particulate residues from PMB operations can lead to catastrophic failure of aircraft systems.

5–4.3.2.7. Post–PMB cleaning. All PMB residue must be removed following blasting operations to prevent damage. Residue can be removed using cleaning methods and materials as specified in Chapter 3. Inspect all openings to ensure no residues remain. Reclean as necessary.

5–4.3.2.8. Quality control. Heavy particles, such as sand, steel or rust particles, and glass beads, shall be kept out of the plastic media. PMB with heavy particle contamination may decrease the overall fatigue life of fatigue critical materials. If contamination is suspected, an impact test may be performed to confirm contamination. The impact test is performed by blasting a QQ–A–250/4, 2024 bare (unclad) aluminum panel (approximately 3 inches x 5 inches x 0.400 inches) once over to simulate paint removal. Inspect the panel for evidence of nicks/pitting. If nicks/pitting are visually evident (without magnification), the media is considered contaminated and must be replaced prior to further blasting. Additionally, to prevent build–up of contaminants, blast cabinets will be thoroughly cleaned prior to each addition of new plastic media. Detailed information concerning detection of contamination and equipment maintenance is provided in the training requirements of paragraph 5–4.3.2.1(c) and NA 17–600–191–6–2.

5–4.3.2.9. PMB waste disposal. Due to toxic materials commonly found in paint, residue generated from PMB processes must be considered a hazardous material unless otherwise directed by local environmental office and disposed in accordance with local environmental regulations.

5–4.4. Chemical paint removal.

CAUTION

Use of acid based paint strippers is not authorized.

Hydrogen embrittlement. When high strength steels (typically 180 ksi and above), some high strength aluminum, and some stainless steels are exposed to acid paint removers, plating solutions, and other acidic chemicals (cleaners, etc.) and even some alkaline materials, a cathodic reaction on the metal surface produces hydrogen, which diffuses into the bulk metal, accumulating at grain boundaries and weakening the structure. If the part is under load or contains residual manufacturing stresses, sudden catastrophic failure occurs when the part can no longer sustain the internal and/or applied stresses. Hydrogen embrittlement has been known to occur in parts stressed to only 15 percent of nominal tensile strength.

NOTE

Paint stripping is authorized when corrosion is suspected/verified prior to magnetic particle or fluorescent penetrant inspection, or to replace damaged paint systems. For paint removal from small areas (less than several square inches), use of medium grade abrasive mats is authorized. Use caution to remove as little metal as possible to properly finish the repair work. Larger areas shall be stripped using TT–R–2918, Type I or MIL–R–81294, Type I paint removers. The use of TT–R–2918, Type I is recommended if the use of methylene chloride, phenol, and/or chromate based paint removers are restricted/prohibited. Aircraft components (except honeycomb and composite parts) may be stripped by tank immersion using AMS–C–19853, which contains methylene chloride, phenol, and chromates. Alternatively, MIL–PRF–83936 (NMP and Monoethanolamine based) hot tank paint remover may be used. This product requires a heated stripping tank capable of temperatures between 160_ - 180_F.

a. MIL-R-81294. Material is a thixotropic, methylene chloride based paint remover that is applied using a nylon bristle brush or by immersing part into a small covered metal tank. Use this chemical in accordance with paragraphs 5.4.4.1 thru 5.4.4.7g. Parts which are only coated with an epoxy primer are very difficult to strip and need to be scrubbed with nylon brushes. Whereas, parts coated with an epoxy primer and a topcoat are easier to strip. Blistered paint can be removed by brushing with a heavy nylon bristle brush and rinsing. Spent stripper and rinse water are hazardous waste and shall be processed per local directives. MIL-R-81294 covers the following types of paint removers, which have been established for specific types of paint.

(1) Type I. For epoxy primer and polyurethane topcoat systems.

(2) Type II. For polyurethanae topcoat systems.

(3) Type III. For paint systems with a polysulfide base coat.

(4) Type IV. For paint systems with an elastomeric polyurethane intermediate coat.

NOTE

Types I and II are available with phenols (Class 1) and without phenols (Class 2). Class 1 products remove paint slightly quicker than Class 2 products, but may present a greater disposal problem because of the phenol content. MIL-R-81294 is NOT suitable for paint removal from composite materials due to it attacking the resin with resultant strength loss in composite fibers.

b. TT-R-2918. Material is a non-hazardous air pollutant (non-HAPs) paint remover, ideal for use in areas where Methylene Chloride is restricted or prohibited. Type I is used for removing epoxy/polyurethane systems while Type II products are designed to remove polysulfide base coating systems. Comply with manufacturer's guidelines. The general application practices for MIL-R-81294 are applicable including the following:

(1) NOT suitable for paint removal from composite materials.

(2) Application of a thin coat using an acid or paintbrush is preferred. Keep material wet by reapplying thin coats of additional TT-R-2918 paint remover periodically.

(3) Paint removal rates may vary with temperature and humidity. The strip rate of the TT-R-2918 material is slower than that of MIL-R-81294. Once applied, keep the TT-R-2918 material wet by periodically re-applying the paint remover to optimize stripping.

(4) Process spent stripper and rinse water as hazardous waste in accordance with local regulations.

c. AMC-C-19853. This material is a liquid carbon remover used in immersion tank application. Type I (phenolic) of this product can also function effectively as a paint remover. The material has a water seal top layer which prevents rapid evaporation of the methylene chloride. Dry blistered paint can be removed by brushing with a heavy nylon bristle brush and then rinsing with water. Spent stripper and rinse water are hazardous waste and shall be processed accordingly.

d. MIL-PRF-83936. Material is a di-phase N-Methyl-2-Pyrrolidone (NMP) and Ethanolamine based hot tank paint remover with a mineral oil seal top layer. MIL-PRF-83936 is limited to intermediate level and above maintenance activities. The following shop practices shall be observed:

CAUTION

Do not attempt to use MIL–PRF–83936 if shop facilities do not have heated (minimum 160_F) stripping tanks. Do not introduce water into the stripping tank, MIL–PRF–83936 is extremely sensitive to water. Parts should be thoroughly dry before they are allowed into the stripping tank. Deviations from the following shop practices will degrade the performance of this chemical.

(1) Use in a heated tank with a thermostat temperature controller.

(2) Use per manufacturer's instructions.

WARNING

Never exceed the manufacturer's recommended temperature for heating and maintaining stripper solution.

(3) Blistered paint can be removed by brushing with a heavy nylon bristle brush and then rinse with water.

(4) Spent stripper and rinse water may be hazardous. Check with local hazardous waste management office prior to disposal.

NOTE

Chemical paint removers shall be stored in a protected area, out of direct sunlight, in a temperature controlled environment maintained between 40_F and 100_F to prevent freezing or exposure to excessively high temperatures. At temperatures out of the aforementioned range, chemical removers rapidly deteriorate and cannot be remixed to form a homogeneous solution and can become corrosive.

5–4.4.1. Shelf–life. Chemical paint removers with an expired shelf–life can seriously degrade the structural properties of high strength steel parts, such as landing gear and arresting hooks, through hydrogen embrittlement resulting in a loss of ductility and cracking of the metal. On high strength steel aircraft components and structural fittings, do not use MIL–R–81294 (methylene chloride based) and TT–R–2918 (benzyl alcohol based) paint removers that have expired (usually 12 months or older from the manufactured date) unless otherwise specified. On aluminum components and structures, MIL–R–81294 paint remover that is within 3 years old from the manufacturer's date may be used. As a rule, if there is evidence that the paint remover has separated into different layers or has become liquified, do not use and dispose of as hazardous waste.

5–4.4.2. Protective measures. Contact the local safety and health office for proper personal protective equipment (PPE).

WARNING

Containers of chemical paint removers are under pressure, even when cold. If pressure is not bled off slowly, remover may splatter violently.

Chemical strippers are toxic and contain ingredients harmful to skin and eye tissues.

No eating, drinking, or smoking is allowed in areas where paint removers or solvents are being used or stored.

Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. In addition to good tank ventilation, use cartridge respirator and ensure good ventilation when in confined areas.

5–4.4.3. When opening a can of chemical remover or when applying chemical remover, the following items shall be worn:

a. Chemical and splash proof goggles;

b. Rubber gloves;

c. Protective clothing (i.e., rubber apron and rubber boots); and

d. Cartridge–type respirator with organic vapor cartridge.

5–4.4.4. When opening, cover the cap or bung of the container with a rag to reduce splatter and turn cap only far enough to break the seal. Allow internal pressure to release slowly and completely before removing cap.

5–4.4.5. First aid. If chemical remover is splashed on the skin, proceed immediately as follows:

a. Rinse affected area with water.

b. Wash affected area thoroughly with soap and water.

c. Flush affected area again with fresh water for at least three minutes.

d. Get medical aid. Do not apply salves or other medications without specific medical department direction.

5–4.4.6. If chemical remover is splashed in the eyes, immediately do the following:

a. Flood the eyes with water for at least 15 minutes.

b. Get medical attention immediately.

5–4.4.7. Procedure.

WARNING

Whenever possible paint removal shall be accomplished in a corrosion control facility designed for paint removal. If not available, ensure adequate ventilation. Army and Navy personnel shall read 5–4.4.2 and 5–4.4.3 prior to using any chemical remover. Air Force personnel shall refer to T.O. 1–1–8 for chemical paint removal.

CAUTION

Epoxy paint removers shall not be used on plastics, fiberglass or graphite composites, or other organic matrix structural composite surfaces. Keep epoxy paint removers away from fuel or water–tight seam sealants, since they will tend to soften and destroy the integrity of sealants. Synthetic rubber parts, aircraft tires, fabrics, and acrylic plastics must be completely protected against possible contact with paint removers.

Use nonmetallic scrapers, heavy nylon bristle brushes, or mild abrasives to assist in the removal of persistent paint finishes.

Chemical paint removers will seriously damage most nonmetallic materials, such as tires, electrical insulation, canopies, fiber–reinforced composite materials, and some sealants. Chemical paint removers with an expired shelf–life can also seriously degrade the structural properties of high strength steel parts, such as landing gear, through hydrogen embrittlement. DO NOT USE paint removers 12 months or older from the manufactured date on high strength steel aircraft components or structural fittings.

Rinsing of epoxy paint removers shall be conducted in a suitable area specified by local safety and environmental directives.

5–4.4.8. The following procedure shall be followed when using epoxy paint remover (MIL–R–81294):

a. Mask acrylic and plastic surfaces, rubber hoses and tubings, exposed wiring, and any other surfaces that can be damaged from contact with the paint remover. Use barrier material (MIL–PRF–131, Class 1) and aluminum foil tape (AMS–T–23397, Type II).

b. To chemical paint strip small surface areas, mask around the area to be stripped using barrier material and aluminum foil tape. Raise tape about 1/2 inch along the bottom of the area as shown in Figure 5–1.

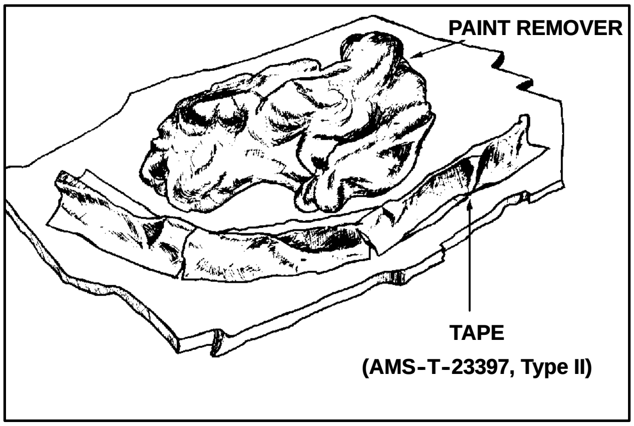


Figure 5-1. Prepare to Remove Paint

c. Prior to application of paint remover, remove excess sealants with a sharp plastic scraper. Then remove the remaining residue using MIL-R-81294.

d. Apply a thick, continuous coating of paint remover to cover the surface to be stripped using a nylon bristle brush or equivalent.

e. Allow paint remover to remain on the surface for a sufficient length of time to wrinkle and completely lift the paint usually 10 to 40 minutes depending on the temperature, humidity, and type of paint being removed. Reapply paint remover as necessary in the areas where paint remains tight or where the material has dried. Micarta scrapers, abrasive pads (A-A-58054) or fiber brushes (A-A-3118) may be used to assist in removing persistent paint. Do not rinse with water until all paint has been loosened. Water greatly reduces the paint stripping efficiency of the remover.

f. Remove loosened paint and residual paint remover by washing and scrubbing the surface with fresh water and a stiff nylon bristle brush or an abrasive pad. If water spray is available, use a low pressure stream of water applied directly to the surface while it is being scrubbed. Do not allow rinsed paint remover or contaminated rinse water to contact other painted surfaces.

g. After thorough rinsing, remove masking materials and thoroughly clean the area in accordance with the cleaning processes outlined in Chapter 3 using MIL-PRF-85570, Type II or AMS-C-29602 cleaning compound in an aqueous parts washer.

5-4.5. <u>Minor paint damage repair.</u> Minor nicks and scratches in paint films can be easily and quickly repaired as follows:

a. Clean the area around the damage to ensure that all traces of oil, dirt, salt, or other contaminants have been removed. Use a cleaning cloth dampened with MIL-T-81772, Type I thinner.

b. Remove any paint film not firmly adhering to the surface using a non-metallic scraping tool.

c. Lightly abrade the area around the damage with a fine abrasive mat or 320 grit abrasive cloth (A-A-1048); feather the edge of the paint film while using care to prevent removal of metal, especially aluminum cladding.

d. Clean the area to be refinished using MIL-PRF-85570, Type II (diluted one part cleaner to nine parts water) and rinse thoroughly. Ensure that all traces of oil and other contaminants have been removed from the metal skin.

e. Apply chemical conversion coating to the clean, bare aluminum surface as described in paragraph 5-9.

f. Apply primer coating, using a small brush or a Sempen t as described in Chapter 7.

g. Apply topcoat paint film, using the same techniques as described for primer. Two or three thin coats are preferred, rather than one heavy coat. The repaired area should have the same paint thickness as the surrounding area.

5-5. CORROSION REMOVAL. There are certain factors that must be considered prior to starting any corrosion removal operation. The most important of these considerations is that the removal of the corrosion products must be completed while not causing additional damage during the process. This can be accomplished by first removing all corrosion visible through a 10X magnifying glass, then removing an additional two mils (0.0020 inch) to ensure that all deposits have been eliminated. Failure to remove all the corrosion may allow the corrosion to continue after affected surfaces are refinished. Additional factors to consider are as follows:

a. Before attempting to remove corrosion products, the surface must be stripped of paint and cleaned. Surface contaminants will interfere with corrosion removal procedures and increase the difficulty of the operation.

b. Adjacent components and parts must be protected from corrosion residue and possible damage that could be caused by the removal operation. Corrosion residue can cause additional corrosion and damage the surface finish of the surrounding area. An accidental slip of a corrosion removal tool can quickly result in additional damage.

c. Prior to corrosion removal, the allowable limits specified in aircraft and equipment manuals and technical orders must be checked. When removing corrosion on critical aircraft structure, the following steps shall be taken:

(1) If allowable metal removal or damage limits will not be exceeded, remove corrosion completely.

(2) If allowable limits will be exceeded, repair or replacement of the part shall be coordinated with the ACC/SPM.

5-5.1. Methods.

CAUTION

Corrosion removal accessories, such as flap brushes or rotary files, should be used on one type of metal only. For example, a flap brush used to remove aluminum shall not be used to remove magnesium, steel, etc.

5-5.1.1. There are various methods of mechanically removing corrosion from metal surfaces. The method used will depend on the type of metal, the location and accessibility of the corroded area, the degree of damage, and the type of corrosion involved. These factors will determine the types of tools and equipment selected for the removal operation. It is very important that the removal method and the tools and equipment selected be compatible with the metal surface. Compatibility involves two considerations: 1) the mechanical effect of the equipment on the surface and 2) the compatibility of metallic particles worn off the removal equipment which might become trapped in the metal surface.

5-5.2. Mechanical compatibility. Mechanical compatibility refers to the selection of the right tools and equipment to prevent additional damage from occurring as a result of the removal process. Often it is necessary to select a series of removal techniques involving the use of different grades or classes of equipment and material to effectively remove the corrosion products. The initial use of a rapid and coarse removal method followed by a slower and finer removal method will produce a smooth metal surface finish (for example, the use of a vacuum blaster at first, and, once the surface is exposed, the use of a fine abrasive cloth or paper).

5-5.3. Material compatibility. Material compatibility refers to using a cleaning medium during brushing, abrading, blasting, etc., that will not be the cause of additional corrosion. Material compatibilities are assured by using like metals during corrosion removal operations. For example, carbon steel wool shall never be used to remove corrosion from aluminum alloy because it can embed in the surface and cause galvanic corrosion of the aluminum alloy.

5-5.4. Non-powered tools and materials.

5-5.4.1. Abrasive mats. Abrasive mats (9”X11” sheets) are nylon webs containing various grades of aluminum oxide abrasive material (A-A-58054, Type I, Class 1, Grade A - Very Fine, Grade B - Fine, Grade C - Medium). These mats are used by hand or with mandrels to remove small areas of corrosion and/or paint where the use of powered tools would be impractical or prevented by the shape or accessibility of the area. Table 5-2 is a guide for abrasive materials.

5-5.4.2. Abrasive cloth. Aluminum oxide (A-A-1048) and silicon carbide (A-A-1200) grit bonded to cloth are used for dry sanding of light to moderate corrosion products. It is available in sheets (9”X11”) and rolls (2” or 3” wide X 150” long) in 240 grit (fine) and 320 grit (very fine) grades.

Table 5-1. Prepaint Treatments for Metal Surfaces

Alloy	Surface Treatment	Procedure
Aluminum alloys	MIL-C-81706, Class 1A (Form III - ready to use pre-mixed liquid)	Immerse part for two to four minutes, use sponge stick applicator, or brush until an irridescent yellow color is obtained. Immediately rinse part thoroughly. Allow to dry (usually eight hours, but do not exceed 48 hours) before painting. See NOTE (1).
	Touch-N-Prep t Pen	Brush clean surface using the acrylic tip of the pen to apply a MIL-C-81706 conversion coating. The treated surface does not require rinsing.
Magnesium alloys	AMS-M-3171, Type VI (chromic acid brush-on treatment)	Immerse part for 30 seconds to two minutes, use sponge stick applicator or brush until a greenish-brown, brassy, or brownish-yellow color is obtained. Immediately rinse part thoroughly. Allow to dry (usually eight hours) before painting. See NOTE (1).
Ferrous metals (other than stainless steel)	None (Treatment prior to painting is limited to corrosion removal and cleaning.)	
Stainless steel and nickel alloys	None (Under engineering guidance, surfaces may be pickled as in Appendix E, paragraph E-22)	
Copper alloys	None (NOTE 2)	
Titanium alloys	None (NOTE 2)	
Plated and phosphated cadmium	None	Solvent wipe to clean the surface.

NOTE: (1) Drying time may be accelerated by blowing with filtered warm air. However, if the air contains oil (from a compressor) or other impurities, the paint which is applied will not pass tape adhesion tests and will probably peel leading to additional corrosion. Drying air temperature should be no more than 140_F (60_C) or conversion coating will degradate and lose its effectiveness.

NOTE: (2) Treatment is limited to corrosion removal and cleaning. These surfaces are not normally painted, but may require painting for decorative purposes, or in instances where the surface will be in contact with a dissimilar anodic metal. Corrosion preventive compounds (CPCs) may be applied as recommended in Chapter 3.

Table 5–2. Grades of Abrasive Mats

Grade	Coated Abrasive (CA) Equivalent
Extra coarse	80 – 100
Coarse	100 – 120
Medium	120 – 150
Fine	180 – 220
Very Fine	280 – 320
Super Fine	320 – 400
Ultra Fine	400 – 500
Flint	500 – 600

Table 5–3. Grades of Steel Wool

Type	Grade	Use
I	Very Fine	Final smoothing
II	Fine	Most commonly used
III	Medium	General purpose
IV	Coarse	Rough work
V	Extra Coarse	Restoration work

5–5.4.3. Abrasive paper. Silicon carbide grit bonded to heavy paper (A–A–1047) is used for wet or dry sanding of light to moderate corrosion products. It is available in sheets in 240 grit (Fine) and 320 grit (Very Fine) grades. Silicon carbide is usually more effective than aluminum oxide on harder metals such as ferrous alloys. Other abrasives are available on paper or cloth (emery and flint) but suffer from poor efficiency and short working life.

5–5.4.4. Metallic wools. Metallic wool is an abrasive material used for removing corrosion that is not tightly bonded to a metal surface. The four major types of metallic wools are: aluminum, copper, stainless steel, and steel. Metallic wools are available in five grades, ranging from very fine to extra coarse. Table 5–3 is a guide to help select the correct grade of metallic wool.

a. The type of corroded metal must be known before using metallic wool. Steel wool is used on ferrous metals; aluminum wool is used on aluminum, aluminum alloys, magnesium, and magnesium alloys; copper wool is used on copper alloys, bronze, and brass; and, stainless steel wool is used on stainless steel. The use of metallic wools which are not galvanically compatible with the metal surface being treated is not authorized.

b. These materials are very good for corrosion removal on tubing or extruded parts. After the use of metallic wools, remove all residue from the metal surface with a vacuum cleaner. Metallic wool particles can create galvanic cells if left on the metal surface.

5–5.4.5. Wire brushes. Wire brushes are used to remove heavy corrosion deposits or paint that is not tightly bonded to the metal surface and are available with aluminum, steel, stainless steel, and brass bristles. Thick, short, and/or stiff bristles are more effective for rapid corrosion removal. The brushes must be compatible with the metal surface to prevent galvanic corrosion. Stainless steel can be considered to be neutral, and can be used on all aviation equipment. Do not use a wire gage or diameter above 0.010 inch, as gouging of the surface may occur. Remove the corrosion with a linear motion; do not cross–hatch. This will unnecessarily damage the surface. After wire brushing soft metal (such as aluminum or magnesium) the surface areas must be polished with fine abrasive paper.

5–5.4.6. Pumice powder. Pumice powder is a very fine and soft abrasive used to remove stains or to remove corrosion on thin metal surfaces where minimum metal removal is allowed. It is mixed with water and then rubbed over the area with a soft cloth. After drying, the powder is wiped off.

5–5.4.7. Scrapers. Scrapers are used primarily for the initial removal of heavy corrosion deposits in corners and crevices that cannot be reached with other equipment. Scrapers of this kind may be locally manufactured from phenolic plastic, fiberglass composites, aluminum or carbide–tipped steel. Plastic scrapers may be used on any metal surfaces; aluminum scrapers shall be used only on aluminum or magnesium surfaces; and steel scrapers shall be used only on steel surfaces. Failure to use the correct metal scraper can lead to galvanic corrosion after the part is returned to service. Normally, surface areas must receive further finishing after corrosion removal with scrapers due to the gouging action of scrapers and the difficulty in determining complete corrosion removal.

5–5.5. Powered tools and materials.

WARNING

Power tool operations create toxic airborne particles often containing heavy metals, such as chromium (in the form of chromates), titanium, nickel, and beryllium, depending on the surface being treated. Eye protection, ventilation, and an adequate respirator for dust control is required.

Do not use hands to probe for air pressure leaks, as injury can result.

Before using any powered equipment, remove clothing which might become entangled in the equipment, as well as rings and other jewelry. Always wear proper personal safety equipment, such as goggles, faceshield, respirator, etc. Ensure that all electrical equipment is grounded.

Powered tools used for corrosion removal is an aggressive method which shall only be used when authorized by cognizant aircraft engineering authority and where extent of corrosion makes non–powered corrosion removal impractical. The indiscriminate use of powered corrosion removal methods will result in damage to protective surfaces finishes and excessive metal removal.

5–5.5.1. Power tools are used to remove heavy corrosion from metal surfaces or mild to severe corrosion over large surface areas. Their use results in saving of time and money. However, care must be exercised when using power tools. Application of excessive pressure can easily damage metal surfaces and cause internal metallurgical changes in the metal due to excessive heat buildup.

5–5.5.2. Pneumatic drill motors. Pneumatic drill motors are the preferred power tools for removing heavy corrosion or reworking large surface areas. The drill motor is normally used with wire brush wheels, rotary files, flap brushes, sanding pads, abrasive wheels, or buffing wheels. These drills are available in many shapes and sizes to satisfy almost any requirement. Check all pneumatic equipment air hoses for breaks or bulges in the coverings. The maximum chuck capacity of the portable powered drill is usually 1/4 inch. Insert the tool shank and tighten chuck securely with the chuck key prior to use. When it is difficult or impossible to reach the work area with a straight drill, use a flexible shaft or angle adapter. The flexible shaft permits working around obstructions with a minimum of effort.

a. To prevent the rotary file, abrasive wheel, or sanding disc from digging into the metal, keep the tool off the metal when initially starting the drill. When the abrading stroke is finished, lift the tool from the metal before releasing the power to the motor.

b. Holding the drill motor with both hands, apply moderate pressure while holding the rotary file, sanding disc, or abrasive wheel against the work. When using the pneumatic tool as a sander, be sure to check the size and type of the abrasive disc. Ensure that the type of disc is compatible with the metal. Keep the sanding disc tilted to approximately a 10 degree angle so that only one side of the disc is in contact with the metal surface. If the entire disc surface is in contact with the surface, a “bucking” effect will occur. Excessive pressure will cause a “chattering” effect. Move the tool over the surface with slightly overlapping strokes. Do not grind, sand, or file in one area for any length of time without stopping and allowing the metal to cool. Excessive heating of the metal will alter its metallurgical structure.

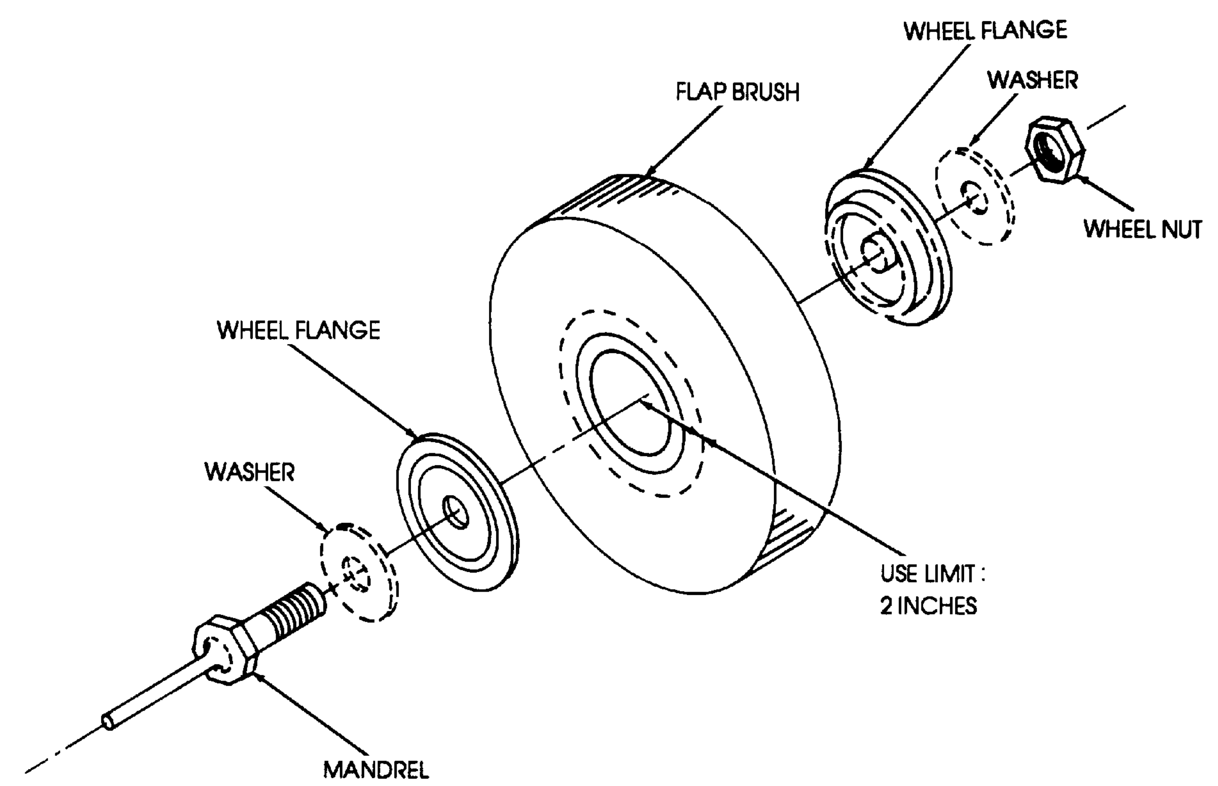


Figure 5-2. Scotch-Brite t Flap Brush and Mandrel

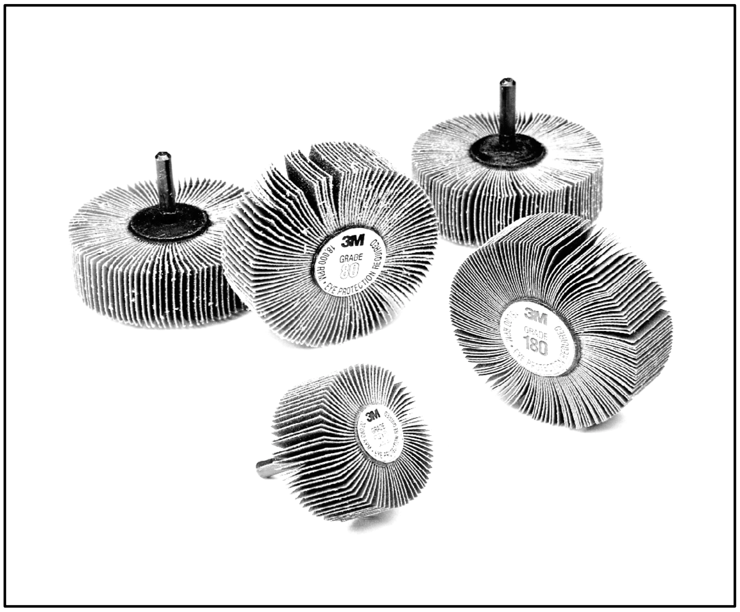


Figure 5–3. Abrasive Flap Wheels with Spindle Mount

5–5.5.3. Pneumatic sanders. The proper technique for using pneumatic sanders with oscillating heads shall include the following:

a. To prevent the sander from digging into the metal, start the sander before it touches the metal. When the sanding strokes are finished, lift the sander from the metal before engaging the stop switch. Do not lay the unit down with the motor running.

b. For best results, apply moderate pressure while holding the sander against the work. Move the sander over the surface with parallel and slightly overlapping strokes. Move it as slowly as possible without overheating the metal. Generally, the cleaning rate should be about two square feet per minute.

CAUTION

Do not use flap brushes (Figure 5–2) down to within 2 inches of core. Continued use beyond this limit may cause gouging due to loss of flexibility of fiber. When using flap brushes, apply minimal pressure to remove maximum paint and minimum metal. Excessive pressure on flap brushes will cause polyurethane paint to melt, gum up, and streak around the area being worked. Do not use on non–metallic surfaces.

5–5.5.4. Scotch–Brite™ finishing flap brushes. Flap brushes are made of non–woven, nylon, aluminum oxide webbing. The brushes are very effective for removing mild surface corrosion and prepping surfaces. It can also be used for mechanical removal and feathering of paint systems. The brushes are comprised of a series of flaps attached to a mandrel (Appendix B) with each flap impacting the surface as it spins. When used correctly, the brushes will lead to minimal metal removal. The flap brush and mandrel (see Figure 5–2) shall be assembled so that the arrow, painted on the brush, is facing the operator or the arrow is pointed in the direction of rotation (clockwise). To achieve maximum effectiveness, use the specified RPM.

5–5.5.5. Abrasive flap wheels. Flap wheels (MIL–W–81319) are made of nylon paper impregnated with aluminum oxide abrasives (Figure 5–3). These wheels usually come with a spindle mount. Depending on grit size, the flap wheels can be used to remove medium to severe corrosion from thick materials. The wheels will also remove metal. Thus, caution must be used to minimize the amount of metal removal. For the most effective use of this equipment, use the specified RPM.

5–5.5.6. Abrasive cloth and paper. Aluminum oxide and silicon carbide cloth and paper can be used with sanders and buffers by cutting suitable pieces from stock.

5–5.5.7. Wire brush wheels.

CAUTION

Unless authorized by the cognizant aircraft engineering authority, rotary wire brushes are not authorized for corrosion removal on soft metals, such as aluminum and magnesium.

5–5.5.7.1. Powered wire brushes are available with various types of wire (straight, twisted, or crimped), various lengths of wire (short, medium, or long), and various wire densities (light, medium, or heavy). Different actions can be obtained by varying wire type, trim length, and density.

5–5.5.8. Rotary files.

CAUTION

Improper use of the rotary file can damage aluminum structure by creating thin spots exceeding damage limits. Its use is authorized only for severe granular or exfoliation corrosion removal by qualified structural repair technicians. Do not use rotary files to remove corrosion from installed fasteners.

5–5.5.8.1. Since it is one of the fastest ways to remove corrosion and underlying metal, a rotary file should be only handled by an experienced structural repair technician. This tool is a tungsten carbide cylinder or cone into which cutting edges have been machined. When installed in the chuck of a pneumatic drill, rapid metal removal can be achieved.

5–5.6. Abrasive blasting.

WARNING

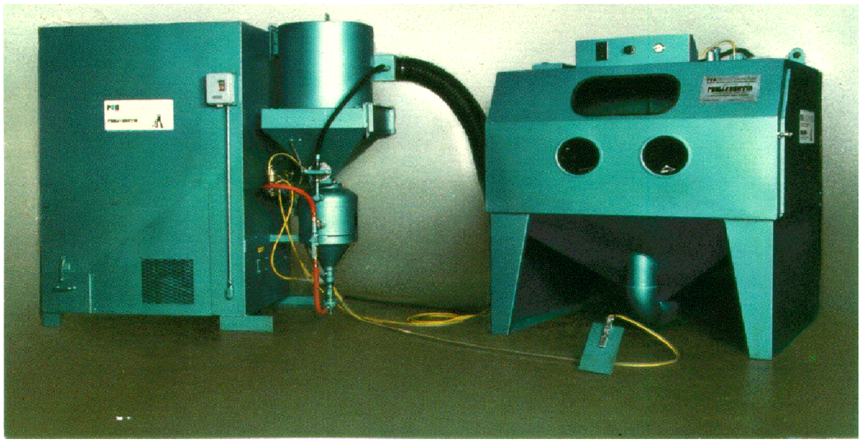
Abrasive blasting operations create airborne particles which may be hazardous to the skin and eyes. A hood, gloves with gauntlets, and adequate ventilation are required.

5–5.6.1. In abrasive blasting, abrasive media propelled toward the work piece with air pressure (conventional or vacuum blasting) or water (wet blasting).

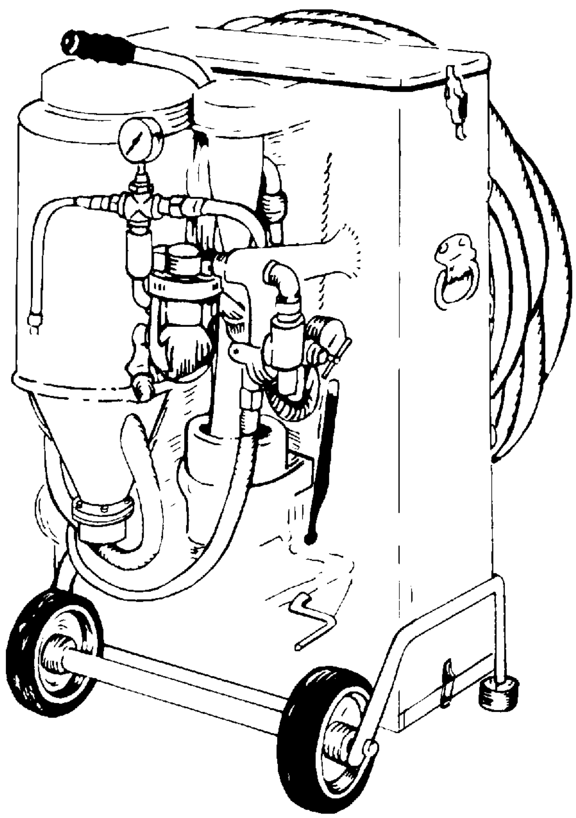
5–5.6.2. Conventional equipment. Two types of equipment are used to propel dry abrasives: direct pressure feed and suction feed. In direct pressure equipment, the abrasive holding tank is a pressure vessel from which abrasive media is forced, through a metering device, into the pressurized blast line to the blast nozzle. In suction equipment, the abrasive holding tank is unpressurized and provides media, through a metering device, into a passing airstream which then propels it through the blast hose to the blast nozzle. Blast cabinets (Figure 5–4(a)), built to accommodate small parts, have a recycle system which removes dust and light particle contaminants, such as paint or corrosion products. Blasting rooms, designed for large components, use a recycling and ventilating system. The operator works within the room, using a blast gun. For mechanical coatings systems removal for Air Force, refer to T.O. 1–1–8 or the system specific manual.

NOTE

Suction feed (also known as venturi equipment) requires higher nozzle pressure than direct pressure equipment to obtain the required abrasive action. Pressures given in Table 5–4 are for direct pressure equipment. As a general rule, increase the nozzle pressure by 50 percent when using suction feed equipment.



(a) Glove box unit



(b) Dry honing machine

Figure 5-4. Abrasive Equipment

Table 5-4. Recommended Powered Abrasives for Corrosion Removal

Alloy	Flap Brush, Abrasive Wheels	Abrasive Cloth/Paper	Abrasive Blasting Parameters: Media (Note 3)	Abrasive Blasting Parameters: Pressure (PSI)	Other Tools
Aluminum alloys (Clad)	Aluminum oxide or silicon carbide	Aluminum oxide or silicon carbide	Glass beads (Sizes 10-13)	30-40 (Note 1)	None
Aluminum alloys (No cladding)	Aluminum oxide or silicon carbide	Aluminum oxide or silicon carbide	Glass beads (Sizes 10-13)	40-45 (Note 1)	Rotary files (fine fluted)
Magnesium alloys	Aluminum oxide or silicon carbide	Aluminum oxide or silicon carbide	Glass beads (Sizes 10-13)	10-35 (Note 1)	Rotary files (fine fluted)
Ferrous metals (other than stainless steel)	Aluminum oxide or silicon carbide	Aluminum oxide or silicon carbide	Aluminum oxide (Type I, A or B) Glass beads (Size 13)	40-50 (Note 1) 40-50 (Note 1)	Rotary files, Wire wheels (steel or stainless steel)
Stainless steel and Nickel alloys	Aluminum oxide or silicon carbide	Aluminum oxide or silicon carbide	(See Note 2) Glass beads (Sizes 10-13)	40-50 (Note 1)	Wire wheels (stainless steel) Rotary files (fine fluted)
Copper alloys	DO NOT USE POWERED ABRASIVE METHODS DUE TO TOXICITY				
Titanium alloys	Aluminum oxide or silicon carbide	Aluminum oxide or silicon carbide	Glass beads (Sizes 10-13) Aluminum oxide (Type I, A or B)	40-50 (Note 1) 40-50 (Note 1)	None
Plated and phosphated surfaces	DO NOT USE POWERED ABRASIVE METHODS DUE TO TOXICITY AND PLATE THICKNESS				

NOTES:
(1) Indicated pressure is for direct pressure equipment. For suction equipment, use 50% higher pressure.
(2) Use only on heavily corroded parts prior to acid pickling.
(3) Media specifications: Glass beads: AMS 2431
Aluminum oxide: A-A-59316

5–5.6.2.1. Blast media. A wide variety of materials and sizes (usually measured by mesh size) are available for blasting applications. Some of the recommended abrasives include aluminum oxide (A–A–59316) and glass bead (AMS 2431). Table 5–4 specifies the correct material, mesh size, and air pressure at the blast nozzle to be used in blasting each type of alloy. For mechanical coatings systems removal for Air Force, refer to T.O. 1–1–8 or the system specific manual.

5–5.6.2.2. Air hoses. The nozzle pressure of the blast stream is affected by the length and inside diameter of the air hoses. It is best to use the shortest hose possible, so that there will not be an excessive pressure drop. If it is necessary to couple lengths of hose, quick connect/disconnect external couplers are recommended.

5–5.6.2.3. Blast nozzles. In general, larger nozzle sizes are preferable to smaller ones, because more area can be cleaned per hour with the same amount of labor. High efficiency nozzles (e.g. tungsten carbide) should be used, since they have a longer use life, require less replacement time, and direct the blasting particles more efficiently. Nozzles should be periodically inspected for wear and discarded when the orifice is worn to a diameter which is 50 percent greater than the diameter when new. A worn nozzle, just as a larger nozzle, will require a larger volume of air flow from the compressor to sustain the needed pressure at the nozzle.

5–5.6.2.4. Air supply. Frictional losses in the hoses reduce the pressure at the nozzle, and nozzle wear increases the volume air needed to maintain the desired nozzle pressure. To allow for nozzle wear, it is generally good practice to have a compressor capability twice that required for a new nozzle. Moisture and oil in the air stream is collected in the abrasive during blasting operations and gradual accumulations will cause the abrasive to clog the blaster. A water and oil separator must be used in the compressed air supply line to reduce excessive moisture or oil.

5–5.6.3. Portable vacuum abrasive blast equipment. Also known as vacu–blasting or dry honing machine, these devices are portable machines designed to recover the abrasive as it rebounds from the work piece. Vacu–blasters have an abrasive hopper, a reclaimer, a dust collector, a vacuum pump and a blast gun which contains both a blast nozzle and a vacuum duct for recovery of the media (Figure 5–4(b)). This equipment is useful only on flat or slightly curved surfaces so that the media rebounds near the vacuum duct surrounding the blast nozzle. Refer to NAVAIR 17–5BM–1, 17–5BM–2, and 17–5BM–3, for Navy equipment; T.O. 1–1–8, T.O. 35–1–3, and systems specific manuals for Air Force; and TM 55–1500 series manuals for Army.

5–5.6.4. Wet abrasive blasting. Wet blasting is a technique using high pressure water as the medium for the delivery of abrasives. This method is not as harmful to the base metal as dry abrasive blasting, due to the cushioning effect of the water medium. Unfortunately, this effect inhibits the speed with which coatings and corrosion products are removed. The abrasive material is normally not recoverable in wet blasting operations, and only sand (MIL–A–22262), aluminum oxide (A–A–59316), or No. 13 glass beads (AMS 2431) shall be used. A corrosion inhibitor solution must be added to the water or applied to the blasted surface immediately after blasting to give some protection from rusting until the part can be painted.

5–6. DAMAGE LIMITS. Complete removal of corrosion products may result in metal removal which exceeds the amount allowed by specific aircraft or equipment repair handbooks. Check the allowable removal limits specified in the applicable aircraft manuals to make this determination. Metal loss damage is cumulative; prior metal loss, including areas on the opposite side of a part, must be considered when assessing corrosion damage. If the metal removal limits are exceeded, repair or replacement of the part or component must be accomplished. When a critical structural component is affected, repairs shall be coordinated with the ACC/SPM in order to determine if the part should be repaired or replaced. Refer to the applicable aircraft manuals for specific repair procedures and restrictions.

5–7. SURFACE FINISH. All depressions resulting from corrosion removal shall be blended smoothly and evenly with the surrounding original surfaces. In critical and highly stressed areas, all pits remaining after removal of corrosion products, by any method, shall be blended out to prevent stress risers which may cause stress corrosion cracking. On non–critical structure it is not necessary to blend out pits remaining after removal of corrosion products since this results in unnecessary metal removal. Check specific aircraft manuals for maximum allowable depth of depressions. The general guidelines for shaping and blending corrosion grindouts are shown in Figures 5–5 through 5–7. For additional information, contact ACC/SPM for blendout procedures.

5–7.1. Pitting on a critical structure. On critical structure having a large number of closely spaced pits, intervening material may be removed to minimize surface irregularity or waviness. The resulting depression shall have no sharp corners and shall be saucer–shaped, wherever clearance permits, with its major axis running spanwise on wings and horizontal stabilizers, longitudinally on fuselages, and vertically on vertical stabilizers (Figure 5–5). In areas where a true saucer shaped depression cannot be formed due to inadequate clearance, blend out a depression as nearly as possible to that shape so that there are no abrupt or sharp edges.

5–8. CORROSION REMOVAL PROCEDURES.

5–8.1. Warnings and cautions. The following warnings and cautions shall be observed during corrosion removal operations.

5–8.1.1. Personal protection.

WARNING

Many materials such as copper alloys (especially beryllium–copper, see paragraph 8–20), cadmium plate, chromate conversion coatings, paints containing chromates, lead, barium, and strontium are toxic. Use approved respirators, eye protection, and skin protection. Take proper safety precautions to avoid inhalation or ingestion during corrosion removal. Wash hands thoroughly before eating or smoking.

All powered corrosion removal procedures create airborne particles. Respirators and eye protection are required.

Wear leather gloves when using metallic wools to prevent hand injuries.

Do not use flap brushes, abrasive wheels, or wire brush wheels above their authorized RPM. These tools can fly apart, causing serious injury.

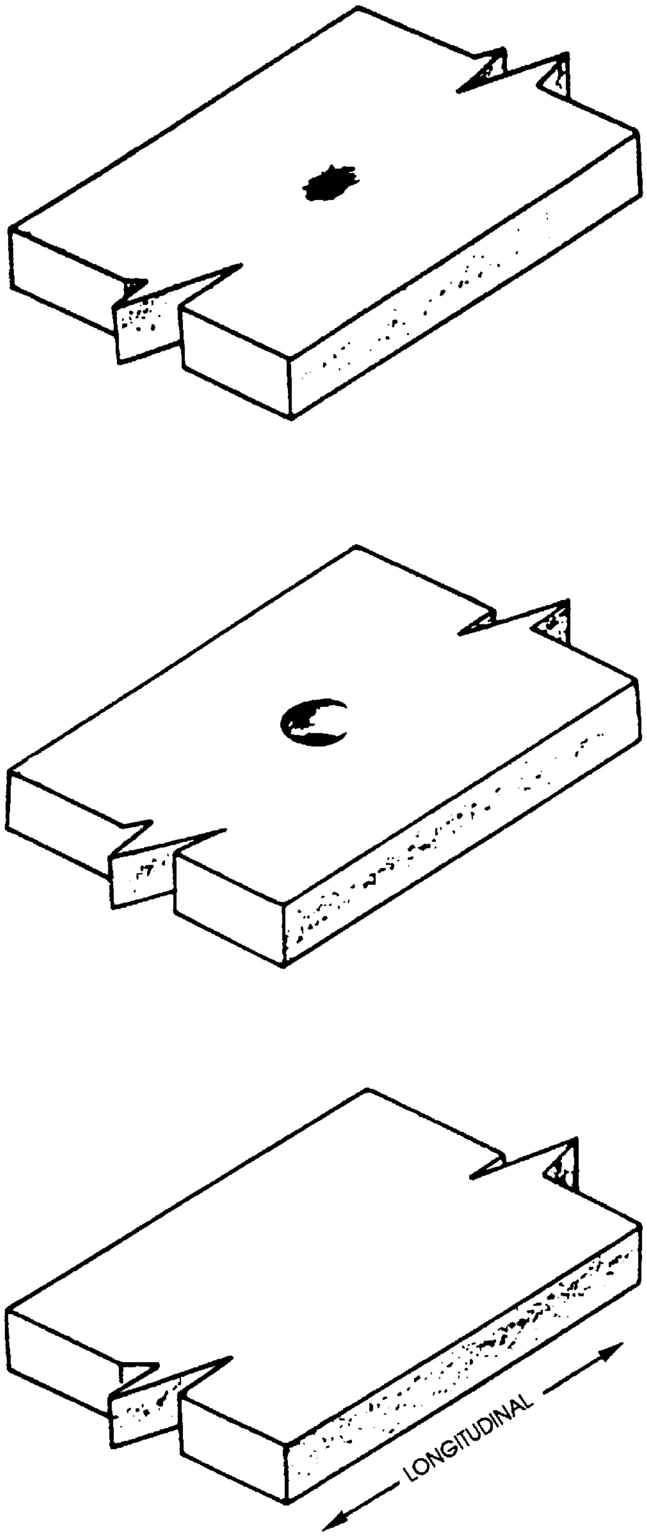
Abrasive blasting operations create airborne particles which may be hazardous to the eyes, lungs, skin, etc. A hood, gloves with gauntlets, and respirator are required.

Exercise caution when using sharp or pointed tools to prevent injury.

Depleted uranium is extremely toxic and shall be worked only under a license from the Nuclear Regulatory Agency (NRA). Machining or other work, such as surface sanding, may be done only by the licensee. No drilling, sanding, or other mechanical work is permitted on depleted uranium by any service maintenance activity. If the protective finish (plating) which covers the depleted uranium is chipped, peeled, or otherwise removed so the dark gray or black depleted uranium (or uranium oxide) is visible, the part must be returned to the licensee for rework or disposal.

Packaging and shipping procedures shall conform to current regulations for handling radioactive materials.

Abrasive cleaning or sanding shall not under any circumstances be applied to depleted uranium.



CORROSION DAMAGE BEFORE REWORK

ROUGH EDGES HAVE BEEN SMOOTHED AND ALL CORROSION HAS BEEN REMOVED. HOWEVER, DEPRESSION HAS NOT BEEN SHAPED.

DEPRESSION AFTER CORROSION REMOVAL

PIT HAS BEEN CLEANED UP TO THE EXTENT THAT ALL LOOSE CORROSION PRODUCTS HAVE BEEN REMOVED.

DISH-OUT AFTER BLENDING

BLENDING HAS BEEN ACCOMPLISHED.

Figure 5-5. Shaping Reworked Areas

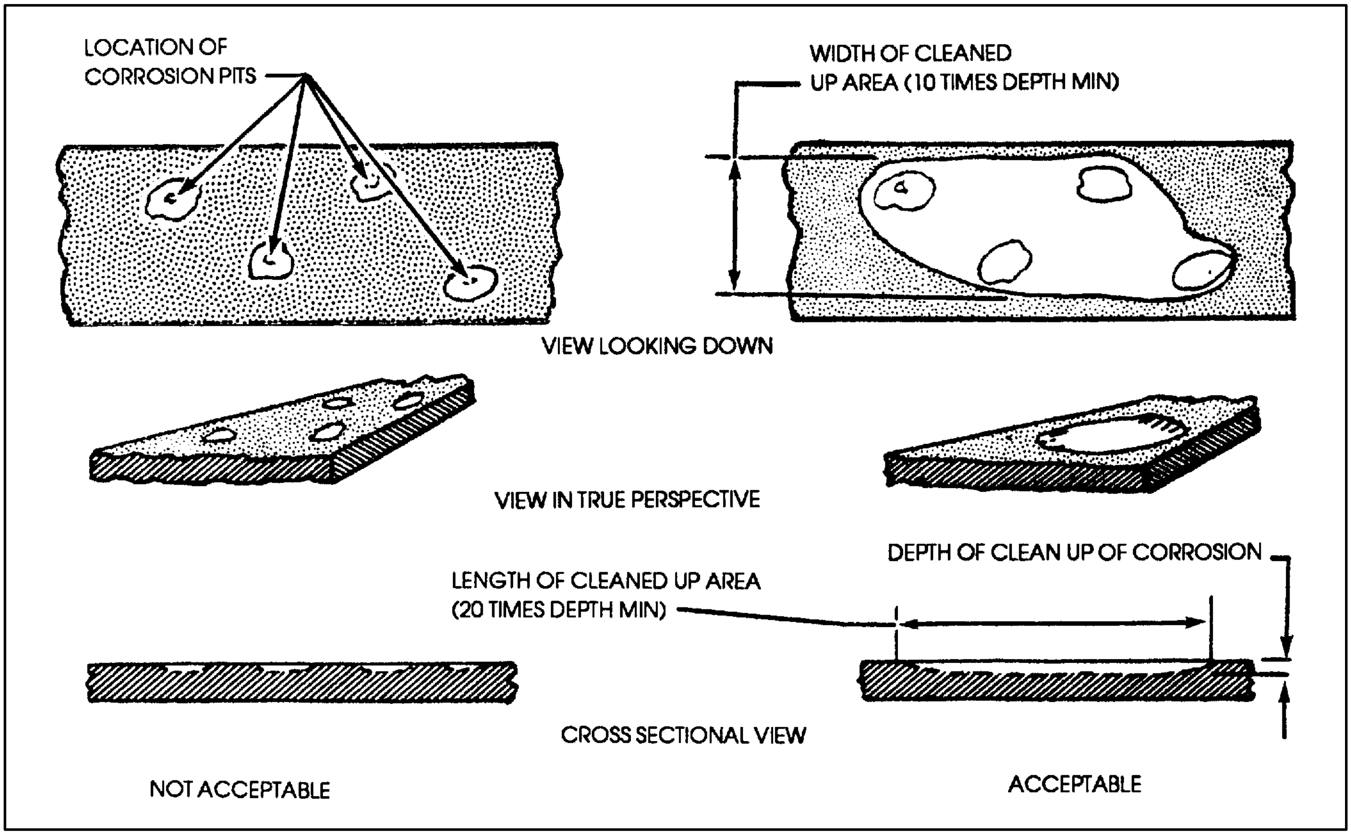


Figure 5-6. Acceptable Clean-up of Pitting Corrosion on Critical Structure

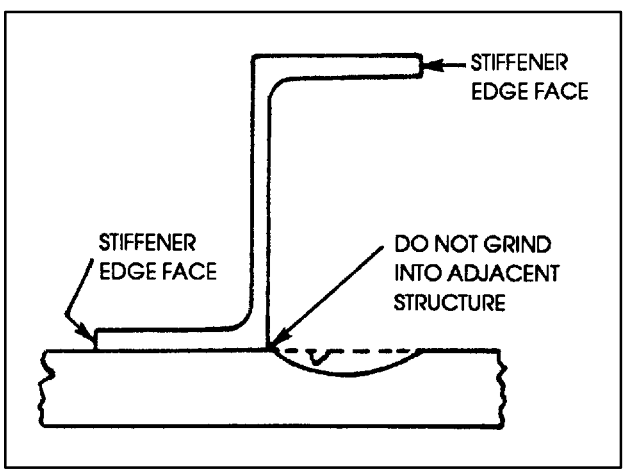


Figure 5-7. Limited Clearance

5–8.1.2. Mechanical damage.

WARNING

Use extreme care to ensure that blast media does not contaminate hydraulic, fuel, oil, coolant, or oxygen systems. Blockages in flight critical components caused by abrasive media particles can result in loss of life and aircraft.

CAUTION

Do not use flap brush down to within two inches from the center of the hub. Continued use beyond this limit may cause gouging due to loss of flexibility of the fiber. Follow direction of rotation, as indicated by arrow imprinted on side surface of core.

CAUTION

Excessive pressure on flap brush will cause polyurethane paint to melt, gum up, and streak around the area being worked.

When using abrasive blasting on aluminum or magnesium alloys, do not allow the blast stream to dwell on the same spot longer than 15 seconds. Longer dwell times will cause excessive metal removal.

Use of rotary files on aircraft or missile skin thinner than 0.0625 inch is prohibited unless authorized by the ACC/SPM. Vigorous, heavy, continuous rubbing (such as with power driven wheels, discs, or flap brushes) can generate enough heat to cause metallurgical damage. Protect these surfaces from severe abrasive action. Do not use rotary files to remove corrosion from installed fasteners.

Mechanical removal of corrosion from depleted uranium shall not be attempted at Organizational unit or Intermediate level maintenance activities.

Protect areas adjacent to corrosion removal operations from chips, dust, and other debris which could produce dissimilar metal corrosion on previously uncorroded surfaces.

Use only the materials recommended in Tables 5–4 and 5–5. Dissimilar metal particles may become embedded in surfaces, leading to rapid galvanic corrosion.

Be careful when removing corrosion from soft plated surfaces (zinc, cadmium, etc.). Soft plating is easily damaged or removed by mechanical methods.

5–8.2. Non–powered corrosion removal. This method is accomplished by hand rubbing the corroded surface with tools or abrasives to remove the corrosion. This method is normally used to remove mild surface corrosion by scraping or wearing away the corrosion products and some base metal. The basic steps are:

a. Prior to removing corrosion, determine whether corrosion can be removed without exceeding the authorized allowable damage limits. If damage limits are exceeded, the part shall be repaired or replaced.

b. Protect adjacent components from scale, chips, corrosion products, and chemical agents. Mask lap joints, hinges, faying surfaces, access doors, air scoops, and other openings which would allow chips, dust, or other debris to enter interior areas. Use barrier paper and masking tape.

c. Clean the affected area to remove grease and soil (see Chapter 3).

d. Using materials in Table 5–5, remove all corrosion using the mildest effective method. To determine whether corrosion has been completely removed, inspect with a 10X magnifier (Appendix B). A more sensitive evaluation can be made using a fluorescent penetrant with magnifier.

e. When complete removal has been attained, blend or fair out the edges of the damaged areas using fine abrasive paper or cloth.

f. After removal of all corrosion, ensure that the allowable damage limits have not been exceeded.

g. Treat the surface in accordance with paragraph 5–9 and apply protective coatings in accordance with Chapter

7 (Navy), T.O. 1–1–8 (Air Force), or TM 55–1500–345–23 (Army).

5–8.3. Powered corrosion removal.

WARNING

All powered corrosion removal procedures create airborne particles. Adequate ventilation, respiratory protection, and eye protection are required.

5–8.3.1. Powered corrosion removal is generally done using pneumatic drills with flap brush, rotary file, sanding pad or abrasive wheel attachments. This method is normally used to remove heavy corrosion by wearing away the corrosion products. Part of the base metal is abraded away with the corrosion products using this procedure. The basic steps in corrosion removal are:

a. Prior to corrosion removal, determine whether corrosion can be removed without exceeding the authorized allowable damage limits. If damage limits are exceeded, the part shall be repaired or replaced.

b. Protect adjacent components from scale, chips, corrosion products, and chemical agents.

c. Clean the affected area to remove grease and soil (see Chapter 3).

d. When complete removal has been attained, blend or fair out the edges of the damaged areas using fine abrasive paper or cloth.

e. After removal of all corrosion, ensure the allowable damage limits have not been exceeded.

f. Treat the surface in accordance with paragraph 5–9 and apply protective coatings in accordance with Chapter 7 (Navy), T.O. 1–1–8 (Air Force), or TM 55–1500 345–23 (Army).

g. Using only recommended materials in Table 5–4, remove all corrosion using the mildest effective method. To determine whether corrosion has been completely removed, it may be necessary to use fluorescent penetrant inspection with a 10X magnifier.

5–8.4. Abrasive blasting safety precautions. Before beginning abrasive blasting operations, observe the following safety precautions. Failure to comply with these precautions may result in harm to personnel and equipment.

WARNING

Use extreme care to ensure that blast media does not contaminate hydraulic, fuel, oil, coolant, or oxygen systems. Blockages in flight critical components caused by abrasive media particles can result in loss of life and aircraft.

Operators shall be adequately protected with complete face and head covering equipment, and provided with pure breathing air meeting the requirements of AFOSH Standard 161–1 and NAVOSH Standard A1–NAVOSH–SAF–000/P–5100–1 when blasting in confined areas.

Finely divided dry particles of many materials (metallic, organic, and inorganic) can form explosive mixtures with air. In dust form, certain metallic materials, notably titanium and magnesium, are capable of igniting spontaneously when exposed to air. Due to potential fire and explosion hazards, one should be careful with these materials for dry abrasive blasting.

Dry abrasive blasting of titanium alloys and high strength steel creates sparking. Take care to ensure that there is no hazardous concentration of flammable vapors present.

After blasting in confined areas, it is essential that all blasting media and other residue be completely removed. The blasting media can be very slippery and can cause dangerous falls.

5–8.5. Blasting procedures.

CAUTION

When blasting aluminum alloys or magnesium alloys, do not allow the blast stream to dwell on the same spot longer than 15 seconds. Longer dwell times will cause excessive metal removal.

5-8.5.1. The blasting operation should be accomplished in the following steps:

a. Inspect areas and surfaces to be blasted and decide what techniques will be used. Clean oil and grease from surfaces with MIL-PRF-85570, Type II or an approved cleaning solvent (e.g. MIL-PRF-680, Type II).

(1) Blasting shall not be used in areas or under conditions that would allow any escaped abrasive particles to contaminate any system, engine, or other component.

(2) Examine all corroded areas for corrosion blisters. If intergranular exfoliation is present, use other recommended mechanical removal methods.

(3) Blasting shall not be performed on surfaces where there is a danger of warping or distorting the base material. Sheet metal, 0.0625 inch (16 gage, U.S. Standard) or thinner shall not be blasted without engineering approval. See the applicable aircraft manuals for limits on metal removal for the particular part.

b. Determine what areas should be protected from the blast stream and from entrapment of the media, and take action to mask or seal these areas. Composite surfaces and those requiring a high gloss surface finish must be effectively protected from the blast. Use impact resistant tape (3M No. 500).

c. Static ground the blaster and equipment to be blasted.

d. Blast corroded areas using the pressures and materials given in Table 5-4. Do not attempt to use pressures higher than those specified, since higher air pressures tend to smear the metal and entrap corrosion products. When cleaning non-ferrous (i.e., aluminum, magnesium, etc.) alloys, never use media which has been used for cleaning ferrous metals. Abrasives used for cleaning ferrous metals will contain many particles of metal which will remain in the abrasive and will contaminate any non-ferrous metal being cleaned. Refer to applicable abrasive blasting equipment instructions.

(1) Direct the blast stream at an angle to sweep across the surface being cleaned (30 to 40 degrees from the surface). Several short passes over the corroded area with the blast nozzle are more effective than one sustained effort. The passes should start a few inches before and end a few inches beyond the area to be cleaned.

(2) Maintain the nozzle distance from the surface being cleaned wherever the best cleaning is obtained. The normal nozzle distance range is from two to six inches.

(3) Continue blasting with short passes over the corroded area to be cleaned until a near-white blast cleaned surface is obtained. A near-white blast cleaned finish is a surface finish from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint, or other foreign matter have been removed.

NOTE

Refer to the individual aircraft manuals for limits on metal removal. Do not exceed these limits without engineering approval.

(4) In critical areas it is necessary to fair out and smooth edges of pits to reduce stress concentrations. The most effective manner is to rotate the blast nozzle around the outer edge of the pit, keeping the nozzle at a constant distance from the work piece and moving at a constant rate. Several short passes over the corroded area with the blast nozzle are more effective than one sustained effort.

e. Upon completion of blasting, inspect for the presence of corrosion in the blasted area. It may be necessary to use fluorescent penetrant inspection with a 10X magnifier. Particular attention shall be given to areas where pitting has progressed into intergranular attack. This is necessary because abrasive blasting has a tendency to close up streaks of intergranular corrosion rather than remove them if the operator uses an improper impingement angle. If corrosion has not been removed in a total blasting time of 60 seconds on any one specific area, other mechanical methods of removal should be utilized.

f. Ensure that the limits of metal removal have not been exceeded, thereby affecting the structural integrity of the piece.

g. Completely clean all residue from the surface and exposed areas using a vacuum cleaner or low pressure air. The vacuum cleaner nozzle shall be plastic or covered with masking tape to protect surfaces from mechanical damage. Clean surface using materials and procedures recommended in Chapter 3. Treat and protect all blasted areas as soon as possible after blasting in accordance with the procedures outlined in paragraph 5-9.

5-8.6. Notes on mechanical corrosion removal.

5-8.6.1. Aluminum. Intergranular exfoliation corrosion is not removed by abrasive blasting; however, blasting may be used in conjunction with powered corrosion removal to determine whether all exfoliation corrosion has been removed.

5-8.6.2. High strength steel. Use only the flap brush and wheel, or abrasive mat to remove corrosion on high strength steel parts. Other power tools are prohibited because of the danger of local overheating and the formation of notches which could lead to failure. Refer to specific maintenance manuals for additional corrosion removal procedures.

5-8.6.3. Stainless steels and nickel alloys. Use abrasive blasting only on heavily corroded parts as a precursor to acid pickling.

CHAPTER 5

CORROSION REMOVAL AND SURFACE TREATMENT

SECTION II. SURFACE TREATMENT

5-9. PURPOSE. An important step in the corrosion control process is the surface treatment of the metal with a prescribed chemical to form a protective film. Properly applied chemical treatment imparts considerable corrosion resistance to the metal, and greatly improves the adhesion of subsequently applied paints. Epoxy primers, for example, which do not adhere well to bare aluminum, adhere very well to chemical conversion coatings.

5-9.1. Chemical prepaint treatments. Also known as chemical conversion coatings, chromate conversion coatings, chemical films, pretreatments, or "alodine", these treatments are aqueous acid solutions of active inorganic compounds which convert aluminum or magnesium surfaces to a corrosion resistant film. In addition, these films improve the adhesion of paint coatings.

5-9.1.1. MIL-C-81706, Chemical Conversion Coating for Aluminum and its Alloys. MIL-C-81706 is a chromate prepaint treatment (with various fluoride activators) for bare and clad aluminum surfaces, including touch-up of scratched/damaged anodized aluminum. Application of this material is covered by MIL-C-5541. MIL-C-81706 has two classes. Class 1A coatings provide maximum protection against corrosion when left unpainted and superior adhesion when paint systems are applied. Class 3 coatings are intended for use as a corrosion preventative film for electrical and electronic applications where low resistance contacts are required. Class 1A is available in the following forms:

WARNING

Form II (powder) contains chromic acid dust which can cause burns of the skin, eyes, and mucous membranes, including irritation and ulcers of the nasal septum. Use rubber gloves, chemical or splash proof goggles, and a dust filter mask when mixing. Chromic acid is a strong oxidizer and may ignite on contact with organic materials and reducing agents.

NOTE

Form II powder shall be mixed in accordance with the manufacturer's instructions.

a. Form I (concentrated liquid) - Thickened, ready for use in touch-up brush applications on vertical or underlying surfaces.

b. Form II (powder) - When water, preferably deionized (DI), is mixed with the powder, a solution equivalent to Form III is formed. Powder has an indefinite shelf life until mixed with water. The unused portions of the mixed solution may be stored in a container and used as required. Once mixed, shelf-life is around six months if the solution is not contaminated.

c. Form III (premixed liquid) - Ready for use in brush (wipe-on/wipe-off), spray, and immersion applications. The premixed liquid is the most commonly used form of MIL-C-81706.

WARNING

The newly formed conversion coating is soft and can be easily removed. Do not disturb the coated surface until coating is completely dry. Maintain drying temperature below 140_F to avoid compromising integrity of the film. Minimum dry time is two hours.

NOTE

Acrylic tip of Touch-N-Prep t (TNP) pen can be modified or altered to form any shape to allow touching up hard to reach areas.

5-9.1.1.1. Conversion coating using Touch-N-Prep t (TNP) pens. The repair of damaged chemical conversion coatings can be accomplished by applying Alodine 1132 using the TNP pens per MIL-C-81706, Class 1A. The TNP pen applicators are ideal for touching-up small surface areas. Use of the TNP pens do not require rinsing or wiping off following applications, thereby minimizing hazardous waste generation. Empty pens can be returned to manufacturer for disposal. To use the TNP pen, remove cap and charge the tip by pressing tip against a flat surface for 10 to 15 seconds. The conversion coating solution will saturate the tip. Do not over-saturate tip. Refresh solution during use in a similar fashion.

a. Clean the damaged area and prepare the surface to be repaired in accordance with paragraph 5-9.2 prior to using the TNP pen.

b. Immediately following cleaning, use the TNP pen to apply a chemical conversion coating solution in overlapping parallel strokes. Do not overapply the solution by allowing puddles, drips, or runs to form.

c. Apply one coat of solution and allow coating to dry for 5 - 10 minutes before next application.

d. Apply a second coat perpendicular to the first coat and allow it to dry. The treated surface does not require rinsing or wiping off, and can be air or forced dried with hot air. Once completely dried, the coating is ready for priming and/or painting.

e. After processing, if bare surface areas still exist repeat steps b. through d. Also if treated surface does not turn to an iridescent yellow color shortly following application, re-clean surface and re-apply (steps a. through d.).

5-9.1.2. AMS-M-3171, Chemical Conversion Coating for Magnesium and its alloys.

WARNING

AMS-M-3171, Type VI, contains chromic acid which can cause burns of the skin, eyes, and mucous membranes, including irritation and ulcers of the nasal septum. Use rubber gloves, goggles, and a dust filter mask when mixing. Chromic acid is a strong oxidizer and may ignite on contact with organic materials and reducing agents.

NOTE

Aluminum conversion coating (MIL-C-81706) is not authorized for treating magnesium surfaces.

5-9.1.2.1. AMS-M-3171, Type VI. A prepaint treatment for all magnesium alloys and can be applied by brushing or immersion. Also known as the Dow #19 process. Use the instructions provided below to prepare a magnesium conversion coating solution or contact a Material Engineering Laboratory at a depot level maintenance activity for assistance.

a. Obtain a one gallon stainless steel, aluminum, vinyl, polyethylene or rubber container.

b. Add 1/2 gallon water, preferably deionized (DI), to the container.

c. Add 1-1/3 ounces (37.8 grams) of Chromic Acid (CrO_3) and then 1 ounce (28.3 grams) of Calcium Sulfate ($CaSO_4.2H_2O$) to the water (see Appendix A for ordering information of chemicals).

d. Top off with enough water to make one gallon of solution and mix thoroughly until Calcium Sulfate has completely dissolved into the solution.

5-9.1.2.2. The part(s) should be clean and free of oil, grease, dirt, etc. prior to the treatment. The surface of the part should be kept wet with solution to produce a brassy or golden brown colored film (usually takes 1 to 3 minutes). After applying the coating, the treated area should be water rinsed.

5-9.1.3. Application tools. Chemical conversion coatings are applied by brush, sponge stick moistener, immersion, or non-atomizing sprayer. The sponge stick moistener is particularly useful for application in very small areas. Rinse sponge stick moistener with water and discard at the end of each work shift.

5-9.2. Surface preparation. After completing corrosion removal, proceed as follows:

a. Feathering edges of paint. Feathering of paint along the edge of areas that have been chemically or mechanically stripped is required prior to pre-treatment and repainting to ensure a smooth, overlapping transition between the old and new paint surfaces. The smooth, overlapping paint film will ensure the absence of a rough, soil accumulating junction between the old and new paint films. Feathering shall be accomplished using 240 or 320 grit aluminum oxide abrasive cloth (A-A-1048), fine or medium aluminum oxide abrasive mat (A-A-58054), or a fine or very fine aluminum oxide finishing flap brush.

b. Clean surface with MIL-PRF-85570, Type II cleaning compound and rinse with water. For water sensitive areas, use an approved cleaning solvent.

c. Abrade the area with a very fine or fine abrasive mat (A-A-58054) to remove the oxide layer/coating. This is the most effective means for cleaning the surface so that it will accept a pre-paint treatment (i.e., chemical conversion coating).

d. After abrading the area, rinse the surface by flushing with fresh water. Particular attention should be given to fasteners and other areas where residues may become entrapped. At this stage of the cleaning process, the surface should be water break-free (Figure 5-8). A surface showing water breaks (water beading or incomplete wetting) is indicative of contamination, which will later interfere with conversion coating, sealing, and painting.

e. If the surface is not free of water breaks, reclean the area by repeating steps b, c, and d.

NOTE

Aircraft that have been waxed, particularly with silicone material, may require special cleaning to obtain a surface free of water breaks. When silicone wax is suspected, solvent clean using an approved cleaning solvent and perform steps c. and d. above.

5-9.3. Precautions. Observe the following precautions when applying chemical prepaint treatments on aluminum or magnesium:

WARNING

Chemical prepaint treatments are toxic and require the use of rubber gloves and chemical or splash proof goggles by personnel during mixing or application. If the material (which is an acid) accidentally contacts the skin or eyes, flush immediately with plenty of clean water. Report to dispensary and/or consult a physician if eyes are affected or skin is burned.

Mixing and application should be done in an adequately ventilated area. Avoid prolonged breathing of vapors.

Chemical film materials are strongly oxidizing and are a fire hazard in contact with combustible and readily oxidizable materials and must be stored separately. Do not store or mix surface treatment materials in containers previously containing flammable products. Rags contaminated with chemical film materials should be thoroughly rinsed and disposed of as soon as it is practicable.

Do not use chemical prepaint treatments on high strength steel. Catastrophic failure may occur due to hydrogen embrittlement.

CAUTION

Do not allow chemical prepaint treatments to enter faying surface areas or other areas where the solutions cannot be adequately removed by rinsing.

Do not use steel, lead, copper, or glass containers for holding/storing chemical prepaint treatments. Use only plastic, rubber, or stainless steel. Brushes with tin plated steel

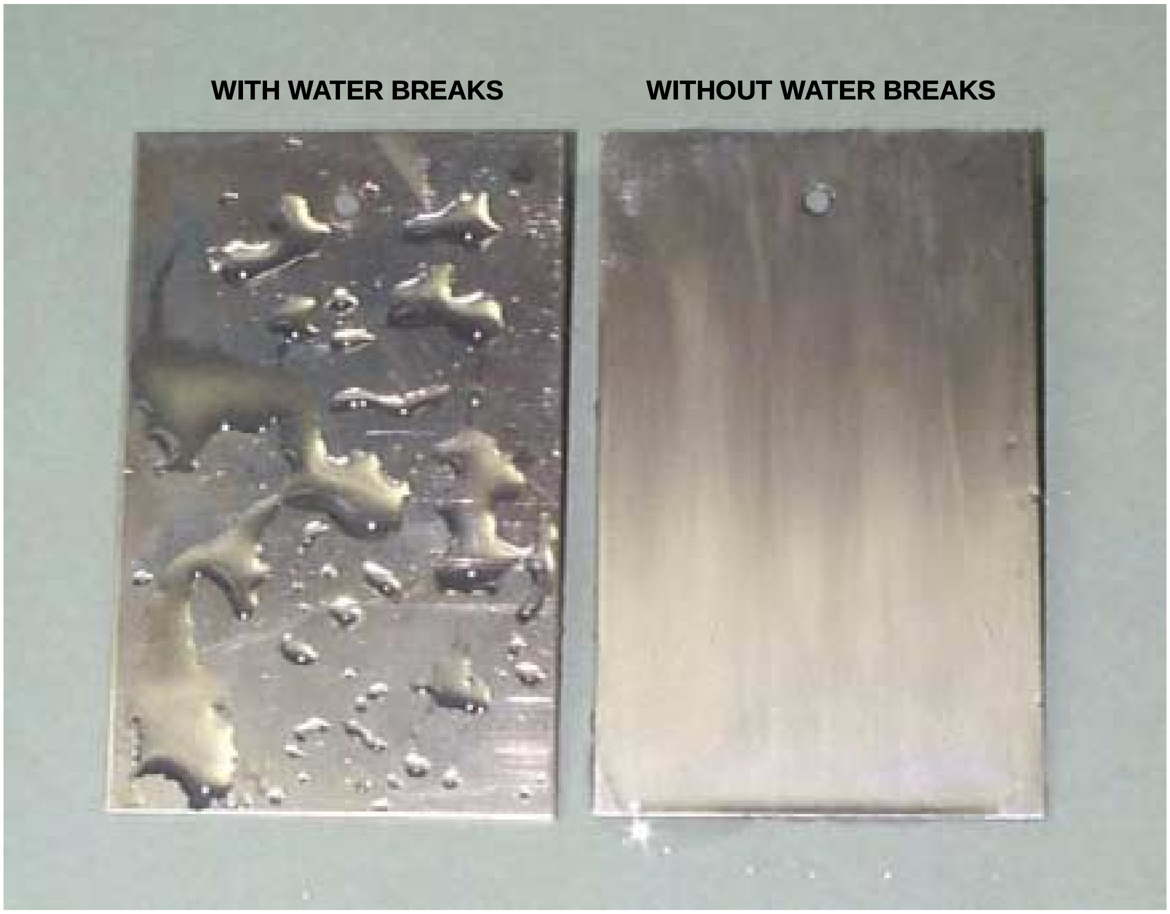


Figure 5–8. A Water–Break Free Surface Compared with One with Breaks

handles or ferrules may be used, but contact with the treatment solution should be minimized.

5–9.4. Application of surface treatments. See Table 5–1 for recommended materials and procedures for specific alloys. Immediately after cleaning to a water break–free surface and rinsing thoroughly, apply chemical conversion coating material by brush, sponge stick moistener, immersion, or non–atomizing spray to achieve finishes described below. The Touch–N–Prep t pens are particularly useful for small areas.

5–9.4.1. Use of recycled rinse water from MIL–C–81706 dip tanks. The recycled rinse water can be used one time only and only under the following conditions:

a. Only rinse water from a dip tank operation can be recycled.

b. A cost benefit analysis must show that it is economical to reuse the rinse water.

c. Before rinse water is reused, four drums (use MIL–D–43703 drums only) shall be collected and a chemical analysis performed in accordance with paragraph 5–9.4.1.1. For each drum, a one–half pint sample in a polyethylene bottle shall be taken to a local laboratory for analysis. In addition, a similar sample of the MIL–C–81706 tank solution shall be taken. Rinse water may be recycled only if the analysis of the four drums yields an average of less than 1.5 percent and individual results less than 3.0 percent, when calculated as in paragraph 5–9.4.1.1.

Table 5–5. Recommended Non–powered Abrasives for Corrosion Removal

Alloy	Non–woven Abrasive	Abrasive Cloth/Paper	Metallic Wool	Brushes	Others
Aluminum alloys	Abrasive Mat	Aluminum oxide, Silicon carbide	Aluminum wool	Stainless steel, Aluminum	Pumice paste, Carbide–tipped scrapers
Magnesium alloys	Abrasive Mat	Aluminum oxide, Silicon carbide	None	Stainless steel, Aluminum	Pumice paste, Carbide–tipped scrapers
Ferrous metals (other than stainless steel)	Abrasive Mat	Aluminum oxide, Silicon carbide	Steel wool	Carbon steel, Stainless steel	Carbide–tipped scrapers
Stainless steel and Nickel alloys	None	Aluminum oxide, Silicon carbide	Stainless steel wool	Stainless steel	None
Copper alloys	None	Aluminum oxide (400 grit), Silicon carbide (400 grit)	Copper wool	Brass	None
Titanium alloys	Abrasive Mat	Aluminum oxide, Silicon carbide	Stainless steel wool	Stainless steel	Pumice paste, Carbide–tipped scrapers
Cadmium or Zinc plated surfaces	Abrasive Mat	Aluminum oxide, Silicon carbide	None	None	None
Chromium, Nickel, Tin, or Copper plated surfaces	Abrasive Mat	Aluminum oxide, Silicon carbide	None	Stainless steel	None
Phosphated surfaces	USE METHOD RECOMMENDED FOR BASE METAL				

d. If there is a change in the MIL-C-81706 manufacturer, the above analysis must be redone using rinse water from the new solution.

e. In addition, rinse water must be rechecked as above at least once a year.

f. For Air Force, use of recycled rinse water must be approved by Command Corrosion Manager or ALC Corrosion Manager.

5-9.4.1.1. Analysis of rinse water for recycling. This procedure determines the concentration of MIL-C-81706 solution in rinse water based on the concentration of hexavalent chromium.

a. Pipette a 10 ml sample of the MIL-C-81706 tank solution into an iodine flask. Add 25 ml of a 25 percent potassium iodide solution, 50 ml distilled water, and 10 ml of 50 percent sulfuric acid. Stopper, shake gently for a few seconds, then add some of the potassium iodide solution to stopper well. Let stand 10 minutes with occasional shaking. Remove stopper and titrate immediately with 0.1 normal sodium thiosulfate to a pale yellow. Add 3 ml of a filtered 1 percent starch solution and continue the titration until the deep blue color disappears.

b. Repeat the above procedure using a 60 ml sample of the rinse water but do not add the 50 ml of distilled water. Use the exact same concentration of sodium thiosulfate for titration (i.e., from the same container).

c. Calculate the percent MIL-C-81706 tank solution in the rinse water as follows:

$$\text{Percent tank solution in rinse water} = 16.7 \times \frac{\text{Titration volume (rinse water)}}{\text{Titration volume (tank solution)}}$$

5-9.5. Notes on metal surface treatment. Prepaint treatments shall be applied immediately after corrosion removal procedures. Failure to obtain a good conversion coating may be attributed to the following:

a. Allowing too long a period of contact prior to rinsing, this can result in a powdery coated surface. Chemical prepaint treatments for aluminum shall be rinsed immediately when the surface has a yellow to gold appearance. A brownish color indicates too long a dwell time and produces a powdery coating. This will not provide a good surface to which the paint system can adhere. If a powdery coating is formed, remove it with an abrasive mat and reapply the material. Long contact times for magnesium pretreatments do not usually cause problems.

b. Allowing the pretreatment solution to contact lead, steel, copper, glass, or other incompatible materials can reduce the effectiveness of the solution and may prevent adequate pretreatment.

c. Insufficiently cleaned metal surfaces. Cleaning must provide a water break-free surface. Refer to paragraph 5-9.2.d.

d. Insufficient dwell time. As the solution approaches its one year shelf life, or at temperatures below 50°F (10°C), more time may be required to form good films.

e. Material is beyond shelf life date. Test solution, using a small sample of scrap aluminum. If a yellow to gold coating is produced within five minutes at 68°F (20°C), the material may be used.

5-9.6. Post treatment. Allow the chemical conversion coated surface to dry for a minimum of one hour before painting or applying temporary treatment. More time may be required at low temperature or high humidity. The coating is soft until completely dried. Do not wipe the area with a cloth or brush when coating is still wet, since wiping will remove the coating. To avoid contamination of the treated surface, prime according to procedures in Chapter 7 (Navy), T.O. 1-1-8 (Air Force) or TM 55-1500-345-23 (Army) within four hours after conversion coating or perform temporary preservation procedures (see paragraph 5-10) as soon as possible. If the surface is allowed to become dirty or is scratched, it must be cleaned with a wet abrasive mat and retreated before any subsequent paint coatings or sealants are applied.

5-10. TEMPORARY PRESERVATION. Under adverse conditions or when the pressure of operations will not permit the use of the corrosion treatment methods, apply corrosion preventive compounds (CPCs) in accordance with Chapter 3.

CHAPTER 6

SEALANTS

6-1. PURPOSE. This chapter covers recommended materials and procedures for the application of sealing compounds to aircraft structures. Sealants prevent the intrusion of moisture, rain, salt water, dust, and aircraft fluids, which can lead to extensive corrosion. Sealants are one of the most important tools for corrosion prevention and control. For sealants to be effective, it is critical that the correct sealant be chosen for a specific area/situation and that it be applied correctly. Only qualified personnel thoroughly familiar with sealants and their application shall be permitted to handle and apply them.

6-2. APPLICATIONS. Sealants are used for the following reasons:

a. Fuel sealing (fuel tanks)

b. Pressure area sealing (cabin areas)

c. Weather sealing (exterior skin surfaces)

d. Firewall sealing (engine and ordnance areas)

e. Electrical sealing (bulkhead wiring, electrical connectors and components)

f. Acid-resistant sealing (battery compartments, relief tanks)

g. Window sealing (windows)

h. High temperature sealing (engine areas, anti-icing ducts, some electronics)

i. Aerodynamic sealing (exterior skin surfaces).

6-2.1. Sealant packaging. Sealants are generally packaged and available as three different units of issue (U/I):

a. Two-Part Can Kit (KT): Package consists of an accelerator (part A) and a base compound (part B) that are pre-measured into separate containers.

b. Semkit cartridge (CA): A complete plastic cartridge assembly that stores, mixes, and applies sealant materials. Semkit packages are convenient because they eliminate the need to measure and handle materials.

c. Premixed and Frozen (OZ): Material is premeasured, mixed, and frozen at extremely low temperatures. The premixed and frozen (PMF) materials are the most convenient package configuration for low usage applications, simply thaw material and use.

6-3. SEALING COMPOUNDS. Table 6-1 lists approved sealing compounds, available types, properties and their intended use. Refer to the applicable aircraft/equipment maintenance manual and paragraph 6-7 for specific information concerning selection of the sealing compound and proper application. Observe the warnings and cautions in paragraph 6-6 when using any sealing compound.

6-3.1. Polysulfide, polyurethane, and polythioether sealing compounds. These materials consist of two components: the base (containing the prepolymer) and the accelerator (containing the curing agent). When thoroughly mixed, the catalyst cures the prepolymer to a rubbery solid. Rates of cure depend on the type of prepolymer, catalyst, temperature and humidity; full cure may not be achieved for as long as 7 days. Refer to Table 6-1 for a general description of these materials.

6-3.2. Silicone sealing compounds. These materials generally consist of one component which cures by reacting with moisture in the air. If silicones are applied too thick or in such a way as to prevent moisture from entering the material, they may not cure at all. In addition, many unauthorized silicone sealing compounds produce acetic acid (vinegar smell) while curing, which can lead to severe corrosion problems. There are two silicone sealant specifications, MIL-A-46146 and MIL-A-46106. Only MIL-A-46146 materials are non-corrosive.

Table 6–1. Sealing Compounds

Specification	Types Available	Properties	Intended Use
MIL–PRF–81733, Sealing and Coating Compound, Corrosion Inhibitive (Polysulfide)	Type I (thin) – for brush or dip application Type II (thick) – for sealant gun or spatula Type III (sprayable) – for spray gun Type IV (spreadable) for extended assembly times	Two–component; Room temp cure; Service temp: –65_ to 250_F; Peel strength: 15 lb/in (min); Corrosion inhibiting; Resists fuel, oil, and hydraulic fluid.	Sealing faying surfaces and for wet installation of fasteners on permanent structure repair.
AMS–S–8802 (supersedes MIL–S–8802), Sealing Compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion (Polysulfide)	Class A (thin) – for brush application Class B (thick) – for sealant gun or spatula Class C (spreadable) – for extended assembly times	Two–component; Room temp cure; Service temp: –65_ to 250_F; Peel strength: 20 lb/in (min); No corrosion inhibitors; Resists fuel, oil, and hydraulic fluid.	Used for fillet and brush sealing integral fuel tanks and fuel cell cavities. Not to be exposed to fuel or overcoated until tack–free.
AMS 3276 (supersedes MIL–S–83430), Sealing Compound, Integral Fuel Tanks and General Purpose (Polysulfide).	Class A (thin) – for brush application Class B (thick) – for sealant gun or spatula Class C (thick) – for extended assembly times Class D (thick) – for hole and void filling Class E (thick) – for automatic riveting equipment	Two–component; Room temp cure; Service temp: –65_ to 360_F; Peel strength: 20 lb/in; No corrosion inhibitors; Resists fuel, oil, and hydraulic fluid.	High temperature applications. Used for fuel tank sealing, cabin pressure sealing, aerodynamic smoothing, faying surface sealing, wet–installation of fasteners, overcoating fasteners, sealing joints and seams, and nonstructural adhesive bonding. For fuel tank applications, treat bond surfaces with AMS 3100 adhesion promoter to enhance sealant adhesion.

Table 6–1. Sealing Compounds (Cont.)

Specification	Types Available	Properties	Intended Use
PR–1773 (supersedes PR–1403G), Sealing Compound, Non–Chromate Corrosion Inhibitive Polysulfide Rubber	Class B (thick) – for sealant gun or spatula	Two–component; Room temp cure; Service temp: –65_ to 250_F; Corrosion inhibitors; Resists fuel, oil, and hydraulic fluid.	Air Force preferred sealant for general purpose, low adhesion sealing of access door and form in place (FIP) gasket.
AMS 3267 (supersedes MIL–S–8784), Sealing Compound, Low Adhesion Strength, Accelerator Required (Synthetic Rubber)	Class A (thin) – for brush application Class B (thick) – for sealant gun or spatula	Two–component; Room temp cure; Service temp: –65_ to 250_F; Peel strength: 2 lb/in (max); No corrosion inhibitors; Resists fuel, oil, and hydraulic fluid.	Fillet and faying surface sealing of removable structure such as access doors, floor panels and plates, removable panels, and fuel tank inspection plates. Not for high temp areas or permanent structure.
AMS 3374 (supersedes MIL–S–38249), Sealing Compound, One–Part Silicone, Aircraft Firewall (Synthetic Rubber)	Type 1 (one–part silicone) – cures on exposure to air Type 2 (two–part silicone) – addition cured Type 3 (two–part silicone) – condensation cured Type 4 (two–part polysulfide) – high temp. resistant	One–component; Room temp cure; Service temp: –65_ to 400_F; Peel strength: 10 lb/in (min); No corrosion inhibitors; Resists fuel, oil, and hydraulic fluid.	Sealing firewall structures exposed to very high temperatures against the passage of air and vapors. Cures on exposure to air.

Table 6-1. Sealing Compounds (Cont.)

Specification	Types Available	Properties	Intended Use
MIL-S-85420, Sealing Compound, Quick Repair, Low Temperature Curing, for Aircraft Structures (Polysulfide)	Class A (thin) - for brush application Class B (thick) - for sealant gun or spatula	Two-component; Low temp curing; Service temp: -65_ to 200_F; Peel strength: 10 lb/in (min); No corrosion inhibitors; Resists fuel, oil, and hydraulic fluid.	Cold temp (40_F) and quick repair sealing of aircraft structures. Use only with recommended adhesion promoter. Not to be used when temp exceeds 80_F or poor adhesion will result.
AMS 3277 (supersedes MIL-S-29574), Sealing Compound, for Aircraft Structures, Fuel and High Temperature Resistant, Fast Curing at Ambient and Low Temperatures (Polythioether)	Class A (thin) - for brush application Class B (thick) - for sealant gun or spatula Class C (thick) - for extended assembly times	Two-component; Low and ambient temp. curing; Service temp: -80_ to 300_F; Peel strength: 20 lb/in (min); Corrosion inhibiting; Resists fuel, oil, and hydraulic fluid.	Multi-purpose aircraft structure and integral fuel tank sealants with rapid ambient and low temperature curing capabilities. Use only with recommended adhesion promoter.
MIL-A-46146, Adhesive - Sealants, Silicone, Room Temperature Vulcanizing (RTV), Non-corrosive (Synthetic Rubber)	Type I - paste Type II - liquid Type III - high strength	One-component; Service temp: -70_ to 400_F; No corrosion inhibitors; Long shelf life; Short cure time.	Convenient one-component sealant for use with sensitive metals and equipment. Not to be used where resistance to fuels, oils, or hydraulic fluids is required.

Table 6–1. Sealing Compounds (Cont.)

Specification	Types Available	Properties	Intended Use
AMS 3255, Skyflex t Sealing Tape, Polytetrafluoroethylene, Expanded (ePTFE)	Class 1: Continuous Ribbed, includes: GUA–1071–1 – for <1” wide fay surfaces; GUA–1001–2 – for >1” wide fay surfaces; GUA–1003–1 – compensation tape; GSC–21–80767–00 – for high moisture areas of floor- boards and thicker fay surface gaps; GUA–1401–1 – for dry areas of floorboards. Class 2: Continuous Non- Ribbed, includes: GUA–1057–1 – for <1” wide fay surfaces, use as shim/ barrier to resist minor chafing; GUA–1059–1 – for >1” wide fay surfaces, use as shim/ barrier to resist minor chafing; GUA–1301–1 – for <1” wide fay surfaces with thick gaps.	Preformed gasket; No mixing, masking, or curing required; Service temp: –65_ to 250_F; Peel strength: 2 lb/in (max); No corrosion inhibitors; Resists fuel, oil, and hydraulic fluid.	Sealing of faying surfaces, access panels, floor- boards, and windscreens. Not for fuel soaked or high temperature applications. Non–hazardous alternative to two–component sealants.

CAUTION

Room Temperature Vulcanizing (RTV) silicones conforming to MIL–A–46106 produce acetic acid (vinegar smell) which is corrosive. Therefore, as a rule of thumb, if the RTV silicone material smells like vinegar, don't use it.

6–3.3. Adhesion promoters. Some sealing compounds may require the application of a special primer or adhesion promoter prior to sealant application in order to develop a good adhesive bond with the surface. Use only those primers or adhesion promoters recommended by the manufacturer for his product. These materials are especially important for MIL–S–85420, AMS 3277 and some silicone based sealants. See Appendix A for a listing and description of adhesion promoters.

CAUTION

Solvent based adhesion promoters are hygroscopic (absorb moisture) and must be kept away from moisture. Discard material if it becomes cloudy or a precipitate is formed.

NOTE

Use of the ePTFE (Skyflex t) sealing tape requires authorization from the cognizant Type, Model, and Series (TMS) engineering authority for the aircraft.

6–3.4. ePTFE (Skyflex t) sealing tape. The sealant tape consists of an extruded gasket with a pressure sensitive adhesive backing. No mixing is required and there are no application life constraints or cure times. The sealing tape does not require removal and replacement unless damaged. The adhesive backing is only required to hold the sealing tape in place until an access panel is (re)installed. Tapes may be special ordered without adhesive backing for use in areas where fluid exposure (e.g. hydraulic fluid or fuel) is expected and applied with a fluid resistant rubber cement. Refer to Table 6–1 for a general description of this material.

6–4. EQUIPMENT. The following equipment is available.

NOTE

Avoid air bubbles as much as possible during the filleting operation. Allow the sealant to cure to, at least, the tack–free stage before moving the assembly.

6–4.1. Sealant gun. The Semco Model 250–A or its equivalent (Figure 6–1) fitted with one of the nozzles from Figure 6–2 is used for the application of fillet seals. When using this gun, the nozzle tip must be pointed into the seam and maintained at a 45 degree angle to the line of travel, forcing the bead of sealant to precede the gun tip to minimize entrapment of air. Use fairing/smoothing tools (i.e., spatulas and spreaders) shown in Figure 6–5 to work sealants and adhesives into seams.

CAUTION

Care should be taken when using rivet nozzles to prevent sealant material from filling fastener holes.

6–4.2. Application nozzles. In addition to the standard, fillet, and ribbon nozzles in Figure 6–2, the countersink and rivet nozzles in Figures 6–3 and 6–4, respectively, can also be used with the sealant guns. Countersink nozzles can be used to apply sealants into the countersink of fastener holes prior to fastener installation. Rivet nozzles are suitable for use to apply sealants into countersink and through hole prior to fastening part(s) with rivets. The rivet nozzles have a spring–loaded tip. It serves as a check valve and allows for dispensing the precise amount of sealant material.

6–4.3. Injection gun. Figure 6–6 illustrates several injection guns used for injecting sealant into confined holes, slots, structural voids, joggles, etc. Follow the procedures outlined in the aircraft SRM for the proper preparation and use of these guns. For hard to reach areas, attach an extension nozzle to the injection tip.

MODEL 250–A PNEUMATIC SEALANT DISPENSING GUN (WITH HANDLE)

*250 (P/N = 250255) . 2–1/2 OZ. CAPACITY

250 (P/N = 250065) . . 6 OZ. CAPACITY

ALL PARTS INTERCHANGEABLE

NOTES:

1. PLASTIC CARTRIDGE AND STEEL SAFETY RETAINER DETERMINE CAPACITY. ALL OTHER PARTS ARE IDENTICAL.
2. TOTAL WEIGHT (6 FL. OZ. GUN) – 15 OZ.
3. LENGTH OVERALL LESS NOZZLE (6 OZ. GUN) – 8–1/2”.
4. PISTOL GRIP HANDLE MAY BE REMOVED TO CONVERT TO LEVER THROTTLE FOR CONFINED AREAS.

*5. 2 1/2 OZ. CAPACITY RECOMMENDED FOR MOST FIELD REPAIRS.

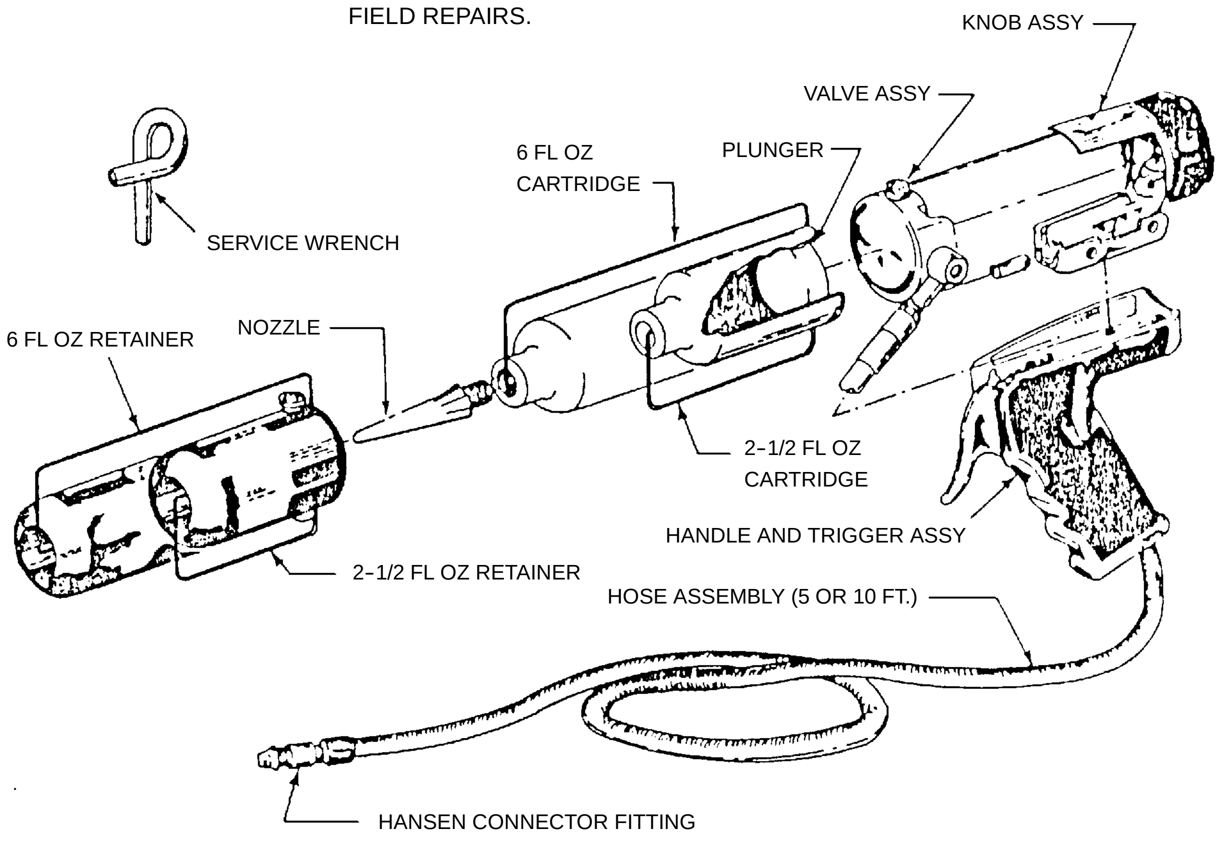
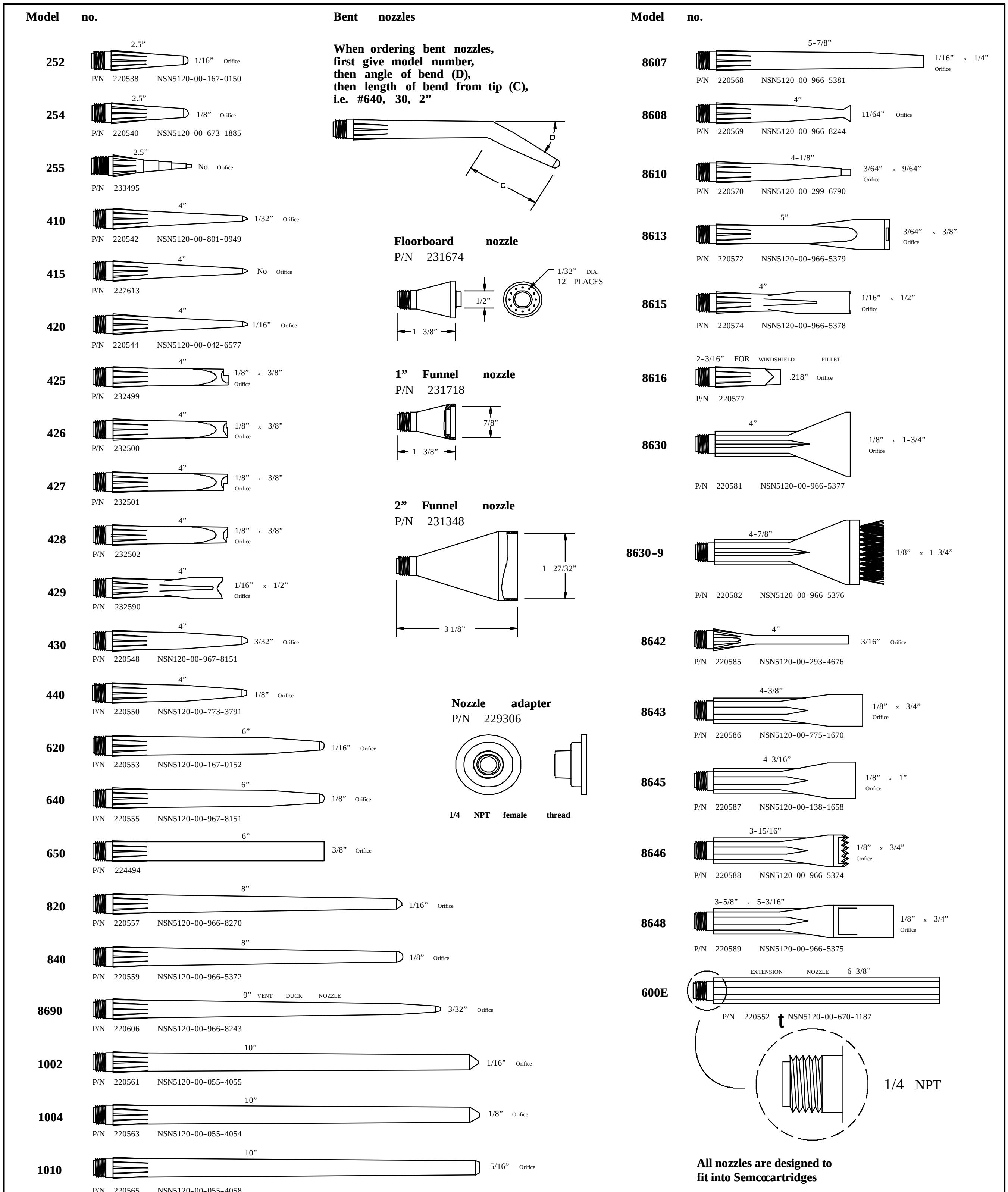
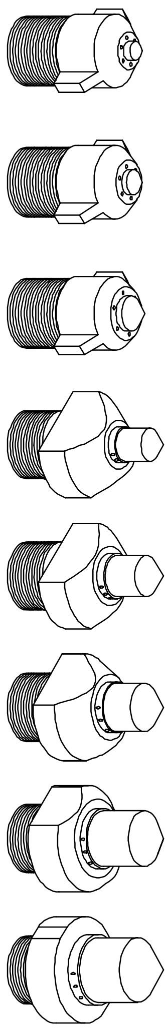


Figure 6–1. Pneumatic Sealant Gun



"Semco" is a trademark of PRC-DeSoto International, Inc.

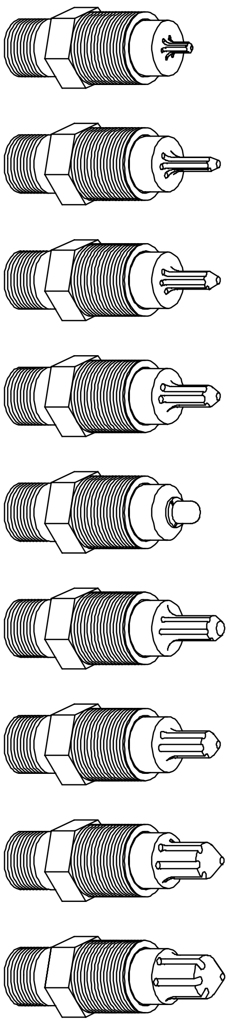
Figure 6-2. Sealant Application Nozzles



Part number	Color	Size	Quantity holes
233244	Red	3/32” – 1/8”	6 holes
233243	White	3/16” – 1/4”	6 holes
233451	Blue	5/16” – 3/8”	6 holes
231319	Yellow	1/4” hole	6 holes – .028”
231320	Grey	5/16” hole	6 holes – .028”
231321	Green	3/8” hole	6 holes – .028”
231560	Red	7/16” hole	6 holes – .028”
231559	Blue	1/2” hole	4 holes – .028”

NOTE: Fastener sealing (countersink) nozzles are used to apply the required amount of sealant in the countersink of fastener holes, prior to installation of fastener. When properly used, sealant will be applied to the perimeter of the countersink and not inside the hole. The assorted fastener sealing nozzle sizes are color coded for identification.

Figure 6–3. Countersink Application Nozzles



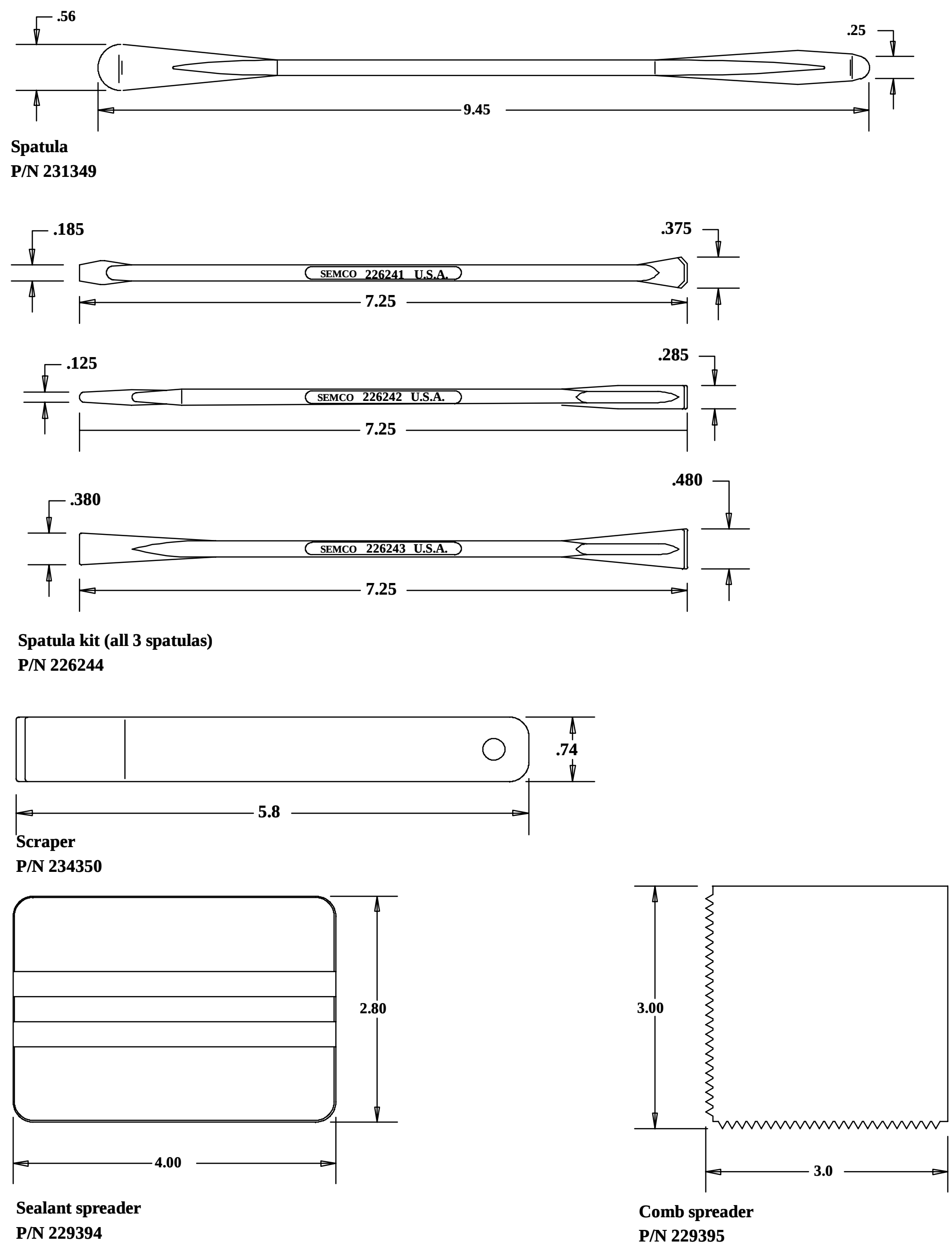
	Part number	Color	Fits hole size	Size and quantity of dispensing holes
3/32”	234285	Germaine green	3/32”	.030” dia., 6 ea. equally spaced
1/8”	226837	Blue	1/8”	.031” dia., 6 ea. equally spaced
5/32”	226838	Black	5/32”	.035” dia., 6 ea. equally spaced
3/16”	226839	White	3/16”	.060” dia., 6 ea. equally spaced
3/16” – 120_	234260*	Green	3/16” – 120_	.030” dia., 6 ea. equally spaced
7/32”	234284	Light Blue	7/32”	.046” dia., 6 ea. equally spaced
1/4”	226840	Red	1/4”	.044” dia., 6 ea. equally spaced
5/16”	233051	Orange	5/16”	.062” dia., 6 ea. equally spaced
3/8”	233052	Yellow	3/8”	.062” dia., 6 ea. equally spaced

***P/N 234260 applies sealant to countersink only.**

NOTE: Rivet nozzles are used to apply the required amount of sealant into the counter–sink and through hole prior to fastening parts with rivets. The spring–loaded tip of the rivet nozzle acts as a check valve allowing precise shots of material to be dispensed. The assorted sizes are color coded for easy identification.

Figure 6–4. Rivet Application Nozzles

Fiberglass reinforced plastic spatulas and spreaders
for tooling and smoothing sealants and adhesives.



All dimensions shown are in inches.

Figure 6-5. Sealant and Adhesive Smoothing Tools

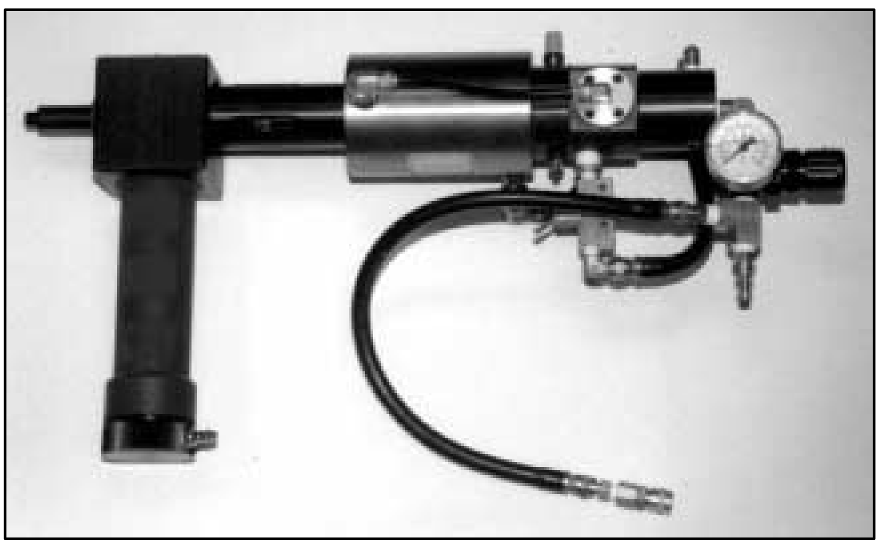


Figure 6–6. Sealant Injection Guns

CAUTION

Before using material, refer to the Material Safety Data Sheet (MSDS) for information on handling precautions.

6–4.4. Sealant kits (Semkit). Certain types of sealants, such as AMS–S–8802 and MIL–PRF–81733, are available as ready to use kits (Semkit). These kits are compact, two-part mixing application units designed for convenient storage, easy mixing, and proper application of the sealant in small quantities. The base sealant is packaged in standard 2–1/2 ounce and 6 ounce cartridges which are placed in a filleting gun or injection gun for application. There are two styles: the Barrier style, which holds proportioned amounts of the two components separated by an aluminum barrier; and the Injection style, which stores the catalyst material within the injection rod to separate it from the base compound prior to use (Figure 6–7). When using Semkits, note that the handle or dasher contains a pre-measured amount of catalyst and should be retained until the ramrod has been operated to release the seal at the bottom of the dasher. All of the material contained inside the two–component Semkit package is mixed within the cartridge.

6–4.5. Sealant removal and applications tools. When removing or fairing out sealants, use one of the sealant smoothing tools shown in Figure 6–5. These tools are commonly used in sealing maintenance work, but other tools may be manufactured as needed to fit a specific situation. Only plastic shall be used to manufacture these sealant removal and application tools.

6–5. SEALANT MIXING. The proper weighing and mixing of components is essential to assure proper curing and adhesion of sealants. Use a weight scale (Appendix B) to accurately measure the materials before blending. Mixing shall be accomplished in one central area in each organization. Polysulfide and polythioether sealants consist of two separately packaged components, a base compound (part B) and an accelerator (part A) in 1/2 pint (6 oz.), pint (12 oz.), and quart (24 oz.) kits. The base–to–accelerator ratio varies with different manufacturers. It is important, therefore, to mix the material according to the manufacturer's recommendations. The accelerator should be added to the base in the correct ratio and mixed until a uniform color is obtained. Difficulties with polysulfide and polythioether sealants are frequently caused by incomplete mixing. The two–part sealants are chemically cured and do not depend on solvent evaporation for curing. Slow mixing by hand is recommended for two–part can kits. A high speed mechanical mixer should not be used as internal heat will be generated reducing application life and introducing air into the mixture. Refer to Figure 6–7 for injection style Semkit mixing instructions.

6–5.1. Application life. Application life and cure times are dependent on environmental considerations. The application life of a sealant is the length of time that a mixed sealing compound remains usable at 75_F (24_C) and 50 percent relative humidity. This time (in hours), known as a dash number, is denoted as the last number in a sealant designation (e.g. MIL–PRF–81733, Type II–2 has an application life of two hours). For each 18_F (10_C) increase in the temperature above 75_F (24_C), the application time is cut by approximately half with a similar reduction in tack–free and cure time. Table 6–2 indicates application times, tack–free times, and full cure times for each sealant type and dash number. When sealants are applied in an environment where the relative humidity is greater than 50 percent, its application life is shortened to some degree. Maintenance personnel should be aware of the effects of temperature and humidity on the application life of a sealant. Mix only the amount of material that can be applied during the rated work life of the sealant.

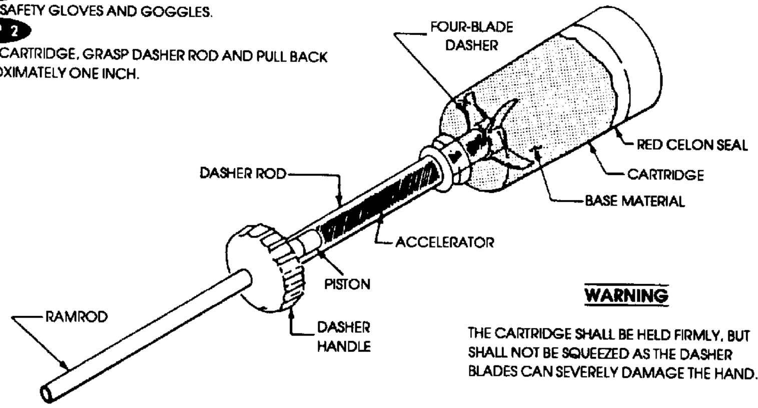
PREPARE PREPACKAGED SEALANT INJECTION CARTRIDGES FOR USE AS FOLLOWS

STEP 1

WEAR SAFETY GLOVES AND GOGGLES.

STEP 2

HOLD CARTRIDGE, GRASP DASHER ROD AND PULL BACK APPROXIMATELY ONE INCH.



NOTE

USE EVEN PRESSURE, DO NOT USE FORCE, TAP, POUND OR JOLT RAMROD IF PISTON DOES NOT BREAK LOOSE READILY.

STEP 3

INSERT RAMROD INTO HOLLOW OF DASHER ROD, BREAK PISTON LOOSE AND INJECT ABOUT 1/3 OF THE CONTENTS INTO THE CARTRIDGE.

NOTE

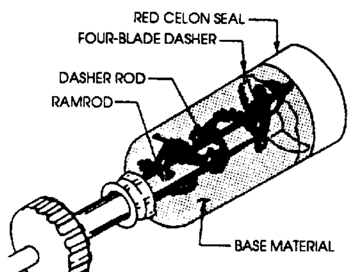
THE RAMROD WILL BE FULLY INSERTED INTO THE DASHER ROD WHEN ALL OF THE ACCELERATOR HAS BEEN FORCED INTO THE CARTRIDGE.

STEP 4

REPEAT STEPS 2 AND 3 UNTIL ALL OF THE CONTENTS OF THE ROD ARE EMPTIED INTO THE CARTRIDGE. THEN REMOVE RAMROD.

STEP 5

REMOVE AND DISCARD RAMROD.



STEP 6

BEGIN MIXING OPERATION BY ROTATING DASHER ROD IN A CLOCKWISE DIRECTION, WHILE SLOWLY MOVING DASHER ROD TO FULL "OUT" POSITION.

WARNING

THE CARTRIDGE SHALL BE HELD FIRMLY, BUT SHALL NOT BE SQUEEZED AS THE DASHER BLADES CAN SEVERELY DAMAGE THE HAND.

CAUTION

THE MIXING MUST BE DONE BY A CLOCKWISE ROTATION OF THE DASHER ROD. COUNTER-CLOCKWISE ROTATION MUST NOT BE USED. BECAUSE THE FOUR BLADE DASHER INSIDE THE CARTRIDGE WILL UNSCREW FROM THE DASHER ROD.

STEP 7

CONTINUE CLOCKWISE ROTATION AND SLOWLY MOVE DASHER ROD TO FULL "IN" POSITION.

CAUTION

A MINIMUM OF FIVE FULL CLOCKWISE REVOLUTIONS MUST BE MADE FOR EACH FULLY "OUT" STROKE AND FOR EACH FULLY "IN" STROKE OF THE DASHER ROD. MIX MATERIAL FOR THE NUMBER OF STROKES RECOMMENDED BY THE MATERIAL MANUFACTURER IN THEIR MIXING INSTRUCTIONS.

STEP 8

END MIXING ACTION WITH DASHER ROD IN FULL "OUT" POSITION.

STEP 9

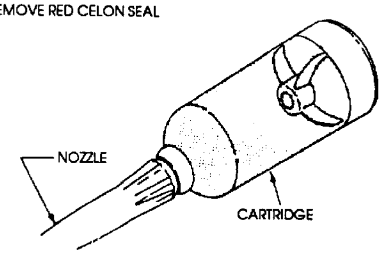
WHILE HOLDING CARTRIDGE IN AN UPRIGHT POSITION, UNSCREW DASHER ROD BY GRIPPING DASHER BLADES IN AREA OF RED CELON SEAL AND TURNING DASHER ROD COUNTERCLOCKWISE.

STEP 10

SCREW NOZZLE INTO CARTRIDGE IF SEALANT FILLETING GUN IS TO BE USED.

STEP 11

REMOVE RED CELON SEAL



STEP 12

INSERT CARTRIDGE INTO APPLICABLE SEALANT GUN. REFER TO SEALANT GUNS.

Figure 6-7. Injection Style Semkit

Table 6–2 Time Requirements for Sealants When Used at 75_ F (24_C)

Specification	Type or Class*	Assembly Time (Hr)	Tack–Free Time (Hr)	Approximate Fly Away Time (Hr)	Application Method(s)
MIL–PRF–81733	I–1/2	--	16	--	Brush
	I–2	--	24	--	Brush
	II–1/2	--	16	--	Gun or spatula
	II–2	--	24	--	Gun or spatula
	II–4	--	32	--	Gun or spatula
	III–1	--	8	--	Spray
	IV–12	20	120	--	Brush or Spatula
	IV–24	80	180	--	Brush or Spatula
	IV–48	168	1008	--	Brush or Spatula
AMS–S–8802 (supersedes MIL–S–8802)	A–1/2	--	10	40	Brush
	A–1	--	20	55	Brush
	A–2	--	40	72	Brush
	B–1/2	--	10	30	Gun or spatula
	B–1	--	20	55	Gun or spatula
	B–2	--	40	72	Gun or spatula
	B–4	--	48	90	Gun or spatula
	C–20	20	96	--	Brush or Spatula
	C–80	80	120	--	Brush or Spatula
AMS 3276 (supersedes MIL–S–83430)	A–1/2	--	10	30	Brush
	A–2	--	24	48	Brush
	B–1/4	--	6	16	Gun or spatula
	B–1/2	--	10	30	Gun or spatula
	B–2	--	24	72	Gun or spatula
	B–4	--	36	90	Gun or spatula
	B–6	--	48	120	Gun or spatula
	C–1/2	--	10	30	Brush or Spatula
	C–2	--	24	--	Brush or Spatula
	C–6	--	48	--	Brush or Spatula
	C–20	20	96	--	Brush or Spatula
AMS 3267 (supersedes MIL–S–8784)	A–1/2	--	10	--	Brush
	A–2	--	24	--	Brush
	B–1/2	--	10	--	Gun or spatula
	B–2	--	24	--	Gun or spatula
AMS 3277 (supersedes MIL–S–29574)	A–1/4	--	1	1.5	Brush
	A–1/2	--	1.5	3	Brush
	A–2	--	9	14	Brush
	B–1/4	--	1	1.5	Gun or spatula
	B–1/2	--	2	3	Gun or spatula
	B–2	--	9	14	Gun or spatula
	C–4	--	--	24	Brush or Spatula
AMS 3255 (ePTFE Sealing Tape)	Class 1	--	0	0	Peel and Stick
	Class 2	--	0	0	Peel and Stick

*The number after the letter indicates the room temperature working life of the sealant after it is mixed.

NOTE

Do not use any two–part sealant after it has been mixed and its rated application life has expired, as poor adhesion may result.

To determine if a sealant is suitable for a specific application, review the individual sealant specification and guidelines provided in Table 6–1.

6–5.2. Storage instructions. When large quantities of sealants are used, it may be advantageous to premix and freeze the sealants to provide a ready supply of mixed sealants when it is needed. Two–part kits and Semkit package sealants should be stored according to instructions on the container. Polysulfide sealants in a pre–mixed and frozen (PMF) form should be stored in a freezer at –40_F (–40_C) or below for optimal retention of application properties and shelf life. Polythioether sealants require extremely low temperature refrigeration at –80_F (–62_C) or below for optimal retention of application properties and shelf life. Thawing of PMF can be accomplished in two ways. For ambient temperature thaw, place the PMF cartridge in a vertical position. Let stand at 70_ – 80_F for approximately 30 minutes. Dry any condensation from the exterior of the cartridge prior to use. For water bath thaw, place the PMF cartridge upright in a 120_F (49_C) water bath for approximately 4–6 minutes. Upon removal from the bath, carefully dry the exterior of the cartridge before using.

6–5.3. Mixing MIL–PRF–81733, Type III. MIL–PRF–81733, Type III has a tendency to settle out during storage. The sealant base must be thoroughly mixed, using a standard paint shaker, to obtain a uniform consistency before the addition of the accelerator. After both components, base and accelerator, have been mixed, add the proper amount of accelerator to the base sealant and mix the combined materials, preferably with a paint shaker, for at least five minutes. For proper application life and cure, the sealant base and accelerator must be combined in the proper ratio and mixed prior to the addition of any thinners (solvents). After mixing, the sealant may be thinned for spraying to a viscosity of 20 to 25 seconds in a No. 2 Zahn cup (paragraph 7–48) using MIL–T–81772, Type I. A 20 to 30 volume percent addition is usually required. The application life and tack–free time will not change using this solvent blend.

6–6. SEALANT APPLICATION PROCEDURES.

WARNING

MIL–T–81772, Type I (or approved equivalent) solvent is flammable. Never use near ignition sources, i.e., lighted cigarettes, electrical arcing, heat sources, etc.

The solvent should be used by applying a small amount to a clean cloth, wiping the surface, and follow by wiping with a clean, dry cloth.

To control solvent odor, “used rags” should be immediately placed in an appropriate HAZMAT container and disposed of per local directives.

Sealants, with the exception of ePTFE sealing tapes, are toxic; therefore, rubber or polyethylene gloves and goggles shall be worn when using these materials. Wash hands thoroughly with soap and water before eating or smoking.

CAUTION

MIL–PRF–81733 is not suitable for use on the insides of integral fuel tanks and shall not be used for these applications. AMS–S–8802 is the authorized sealant for the insides of integral fuel tanks.

No RTV sealant which produces acetic acid shall be used on aircraft. No RTV sealant shall be used in areas where exposure to fuels and oils will be encountered. If RTV sealants are required by the structural repair manual, ensure that the sealant conforms to MIL–A–46146, non–corrosive, RTV silicone adhesive/sealants (for use on sensitive metals and equipment), or is listed in Appendix A as being noncorrosive. RTV silicone adhesive/sealants conforming to

MIL–A–46106 emit acetic acid and, therefore, are corrosive.

NOTE

AMS–S–8802 sealant should not be exposed to fuel or overcoat until it is tack–free. AMS–S–8802 is used to fillet and brush seal fuel tanks only.

Do not use AMS 3267 sealants in high temperature areas or for permanent structural installations. Some typical uses of AMS 3267 sealants include sealing aircraft floor panels and plates and fuel tank inspection plates.

6–6.1. Cleaning. If the surfaces have been contaminated following surface treatment, clean the area with a clean cheesecloth (A–A–1491) or a non–woven cleaning cloth (A–A–162) saturated with AMS 3166 or A–A–59281, Type I or II (or approved equivalent) solvent, beginning at the top of the area to be sealed and working downward. Dry the surfaces immediately with a clean cloth. Do not allow solvent to evaporate from the surface because it will allow some or all of the oil, dirt, etc. to redeposit, making it impossible to be removed with a dry cloth. Use a stiff bristle brush to clean around bolts, rivets, etc.. Always use clean cheesecloth as each new area is cleaned. Following the removal of corrosion and application of surface treatment in accordance with Chapter 5, Section II, with the exception of internal fuel tank surfaces, all surfaces shall be primed with MIL–P–23377 in accordance with Chapter 7 (Navy), T.O. 1–1–8 (Air Force) or TM 55–1500–345–23 (Army), and allowed to dry one to two hours at ambient temperature before sealing.

NOTE

Always pour solvent on the cloth to avoid contaminating the solvent supply. Reclaimed solvents or soiled cleaning cloths shall not be used. After surface treatment and primer application, do not contaminate areas to be sealed with soiled hands or tools.

6–6.2. Masking. To prevent sealant from contacting adjacent areas during application and smoothing out operations, the surrounding area not being sealed can be masked off with AMS–T–21595, Type I masking tape (Figure 6–8). In cases where the tape is likely to remain in place for more than two days on items exposed to direct sunlight and where tape residue on the surface cannot be tolerated, use AMS–T–22085, Type II (3M No. 481) preservation and sealing tape. Examples of where masking tape may be useful is during fillet sealing of exterior surface lap and butt seams.

6–6.3. Adhesion promoters. In some cases, it may be necessary to improve the adhesion of sealants. This can be accomplished by the use of adhesion promoters. Adhesion promoters are solvents that contain additives which will leave behind a sticky residue after evaporation to promote adhesion. To apply, just wipe surface to be sealed with the liquid solution. Allow the treated surface to dry by evaporation. After applying the adhesion promoter, do not touch the treated area for 30 minutes to an hour before applying sealant. For example, using AMS 3100 adhesion promoter (e.g. P/N: PR–148 or PR–182) is essential to repairing integral fuel tanks where new sealant will be applied over aged, fuel soaked polysulfide sealant. If a polythioether is to be applied over a polysulfide sealant, P/N: PR–186 is recommended for use at the sealant interface. Refer to Appendix A for a description of adhesion promoters.

NOTE

Always pour solvent onto a new cloth to avoid contaminating the solvent supply. Clean one small area at a time. Reclaimed solvents or soiled cleaning cloths shall not be used.

6–6.4. Surface preparation. Immediately before applying adhesion promoter to substrates, the surfaces shall be cleaned with a solvent (AMS 3166, A–A–59281, Type I or II, or equivalent). Contaminants such as dirt, grease, and/or lubricants must be removed. Apply a thin coat of the adhesion promoter to the solvent cleaned surface with a clean cloth and allow surface to dry for approximately 30 minutes. After drying, wipe off excess with a clean cloth and start the sealant procedure. If surface becomes contaminated or sealing is not accomplished within an hour after application of adhesion promoter, repeat cleaning procedure.

6-6.5. Brush spatula or caulking gun application. Prior to masking and sealing, prepare surface in accordance with paragraph 6-6.1.

CAUTION

Do not contaminate areas to be sealed with hands, tools, etc. after surface treatment and primer application.

a. To prevent sealant from contacting adjacent areas during application and smoothout, outline the areas being sealed with masking tape (AMS-T-21595, Type I) so that each tape strip is 1/8 to 1/4 inch from the edge of the seams. If tape residue on these surfaces is excessive, remove adhesive residues using aliphatic naphtha (TT-N-95, Type II) or equivalent. Examples where masking may be beneficial include the fillet sealing of exterior surface lap and butt seams.

b. Apply sealant between tapes.

(1) Thick sealants may be applied with a non-metallic spatula or spreader as shown in Figure 6-8. Avoid the entrapment of air. Work sealant into recesses by sliding the edge of the spatula firmly back over the recesses.

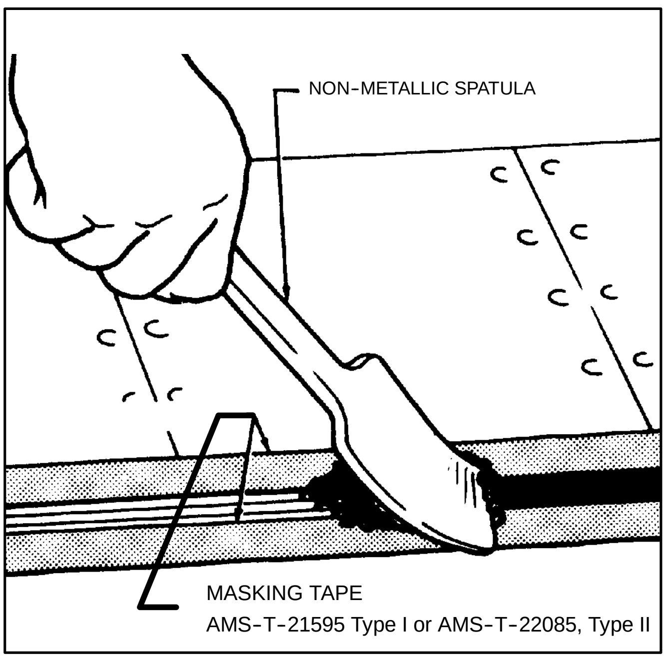


Figure 6-8. Non-metallic Spatula

Smoothing will be easier if the non-metallic spatula is first dipped in water.

(2) Sealant to be applied with a brush is applied and smoothed until the desired thickness is reached.

(3) Sealant applied with a caulking gun will not usually require masking and is especially adaptable to filling seams or the application of form-in-place gaskets.

c. Remove masking tape after the sealant has been applied and before it begins to set. Cure time will depend upon the application life of the materials used.

d. When sealant no longer feels tacky, prime with MIL-P-23377 or other primers as required. Apply topcoat as necessary.

6-6.6. Spray gun application. Prior to masking and sealing, prepare surface in accordance with paragraph 6-6.1.

CAUTION

If any dirt or oil residues accumulate after conversion coating, clean thoroughly with solvent to ensure paint primer and sealant adhesion.

a. Mask off adjacent areas with barrier material held in place with masking tape (AMS-T-21595, Type I).

b. Apply MIL-PRF-81733, Type III sealant in a solid, continuous pattern when spraying over seams whose configuration is less than 14 inches apart. On seam connections greater than 14 inches apart, minimize overspray to adjacent areas.

c. Allow at least four hours for the spray sealant to dry.

NOTE

The dried film of the spray sealant shall have a minimum thickness of 6 mils (0.006 inch).

6-6.7. Skyflex t sealing tape, peel and stick application. Prior to application, prepare surface in accordance with paragraph 6-6.1.

CAUTION

After surface treatment and primer application, do not contaminate areas to be sealed with soiled hands or tools.

a. Examine faying surfaces to be sealed and build up any uneven areas on the aircraft frame with compensation tape (P/N: GUA–1003–1 or equivalent) to create a level faying surface for panel sealing.

b. Select either P/Ns: GUA–1001–1, GUA–1017–1, GSC–21–80767–00, GUA–1401–1, GUA–1057–1, GUA–1059–1, GUA–1301–1, or equivalent. The sealant tape should cover the full width of the faying surface to be sealed. Tape may be applied to either aircraft frame or panel faying surface.

c. Measure and cut the desired length of ePTFE sealant tape that is required.

d. For corners on aircraft/panel, cut ends of tape at a 30 degree angle so that the sealant tape from the converging side will overlap by one–quarter to one–half inch. Do not fold the tape in corners. This will result in triple layer thickness.

NOTE

Use care not to pull or stretch the ePTFE tape as it is applied. The stretched ePTFE tape will retract even if it is clamped between faying surfaces.

e. Peel the non–stick backing paper off the sealant tape a little at a time as the tape is applied to the aircraft/panel.

NOTE

Applying extra pressure to the sealant tape will cause the pressure sensitive adhesive to better adhere to the faying surface and it will create indentations/discoloration at the fastener holes allowing for easy identification.

If sealant without adhesive backing has been ordered for use in areas where fluid exposure is expected, Scotchgrip 847 or 1099 plastic adhesive (Appendix A), or equivalent, may be used to hold the ePTFE sealing tape in place.

f. After applying the full length of the sealant tape, run fingers back and forth on the sealant to press tape against the aircraft structure/panel surface to activate adhesive.

g. Puncture all fastener holes using an object with a sharp point such as an awl/scribe or scissors.

NOTE

As fasteners are installed, the ePTFE sealant material pushed into the fasteners will help to seal against moisture intrusion.

h. Install access panel.

NOTE

No curing time is required. All fasteners should be wet installed with MIL–PRF–16173, Grade 4 Corrosion Preventive Compound (or equivalent as specified in each aircraft's maintenance manual).

6–7. SEALING OF SPECIFIC AREAS.

6–7.1. Faying surface sealing. Faying surfaces are sealed by applying sealants to the contacting surfaces of two or more parts (Figure 6–9). It is a very effective seal and should be used for all assembly or reassembly. When possible, it should be used in conjunction with fillet sealing. There are two types of faying surface seals, removable and permanent. Removable seals are used around access doors, removable panels, inspection plates, etc. A removable seal can be formed using an adhesion sealant, or by using an adhesion sealant on one surface and a parting agent on the mating surface. Permanent seals are created using sealants between permanently fastened structures. To create a permanent seal, coat both mating surfaces with sealant before assembling part. Apply enough sealant to force a bead to squeeze out along the joint after assembly. Assemble parts within the rated application life of the sealant.

a. All faying surfaces, seams, and lap joints shall be protected with MIL–PRF–81733 sealant. Apply the sealing compound to one or both surfaces and squeeze the part together to ensure the complete coating of the entire surface. Excess material squeezed out shall be removed so that a fillet seal remains. The fillet width shall not be less than 1/4 inch. Joint areas which could hold water shall be filled with MIL–PRF–81733 sealant. If sealing is impossible because of mechanical or other factors, prime both surfaces with two coats of MIL–P–23377 in accordance with Chapter 7 (Navy), T.O. 1–1–8 (Air Force), or TM 55–1500–345–23 (Army).

b. Faying surfaces that are to be adhesive bonded shall be treated and processed as specified by the approved bonding procedure in the applicable maintenance manual.

c. On faying surfaces, seams, or joints which require disassembly for maintenance, AMS 3367 or P/N: PR–1773 (Air Force preferred) low adhesion sealant shall be used (P/N: PR–1773 sealant contains non–chromate corrosion inhibitors).

d. On plastic components, the joint shall be suitably sealed and faired into the adjacent surfaces with MIL–PRF–81733 sealant, unless otherwise specified in the applicable maintenance manuals, to stop the formation of pockets which will entrap moisture, dirt, etc.

NOTE

MIL–PRF–81733 sealant shall be used for rivets that require wet installation on plastic components.

6–7.2. Fillet sealing. The fillet, or seam seal, as shown in Figure 6–10, is the most common type found on an aircraft. Fillet seals are used to cover structural joints or seams along stiffeners, skin butts, walls, spars, and longerons, and to seal around fittings and fasteners. This type of sealing is the most easily repaired. It should be used in conjunction with faying surface sealing and in place of it if the assembly sequence restricts the use of faying surface sealing.

6–7.3. Injection sealing. This type of seal, as shown in Figure 6–11, is used primarily to fill voids created by structural joggles, gaps, and openings. USE ONLY THOSE SEALANTS RECOMMENDED BY THE AIRCRAFT/ EQUIPMENT MANUFACTURER. Force sealant into the area using a sealant gun. This method is a means of producing a continuous seal where it becomes impossible to lay down a continuous bead of sealant while fillet sealing. Clean the voids of all dirt, chips, burrs, grease, and oil before injection sealing.

6–7.4. Fastener sealing. Figure 6–12 illustrates techniques used to seal different types of fasteners. Fasteners are sealed either during assembly or after assembly. Wet set in accordance with SRM for fasteners on permanent structures. To seal during assembly, apply the sealant to the hole or dip the fastener into sealant, and install fastener while sealant is wet. For removable parts, coat the lower side of the fastener head only. Do not coat the hole or the fastener shank or threads, as this makes future removal almost impossible without damage to the part. To seal after assembly, cover the pressure side of the fastener with sealant after installation. Corrosion damaged areas in the countersinks around removable and fixed fasteners may be filled with the fastener in place. Cadmium coated fasteners that have been blasted or abraded during corrosion removal shall be primed in accordance with Chapter 7 (Navy), T.O. 1–1–8 (Air Force), or TM 55–1500–345–23 (Army) and coated with MIL–PRF–81733 sealant.

6–7.5. Fuel cells. Refer to NAVAIR 01–1A–35, T.O. 1–1–3, TM 55–1500–204–25/1, or aircraft's Structural Repair Manual (SRMs) for sealant procedures.

6–7.6. Form–in–place sealant repair. After removal of all loose sealant material, thoroughly clean the area to be re–sealed. Areas of old seal to which new sealant will be added must be cleaned and abraded using an abrasive mat or abrasive cloth to expose a clean, fresh surface.

a. Apply MIL–PRF–81733, Type II–1/2 sealant, preferably with a sealant gun. The new sealant should match the configuration of the removed sealant but should be of sufficient depth to ensure contact with the mating surface.

b. Apply a very thin film of VV–L–800 to the non-stick mating surface and close the access door.

c. Do not open the door for a minimum of 24 hours.

6-7.7. ePTFE gasket repair. In order to preserve sealant integrity, it is necessary to inspect the sealant tape each time an access panel is removed.

NOTE

The main function of the adhesive backing is to hold the ePTFE sealant tape in place. Peeling/delamination of the adhesive from the aircraft structure/panel requires replacement of the sealant tape if the tape is no longer located in the faying surface.

a. Visually inspect ePTFE sealant material for nicks, cuts, gouges and delamination/separation.

b. Cut and remove damaged section of sealant.

c. Measure and cut a new piece of sealant approximately one inch longer than the removed section.

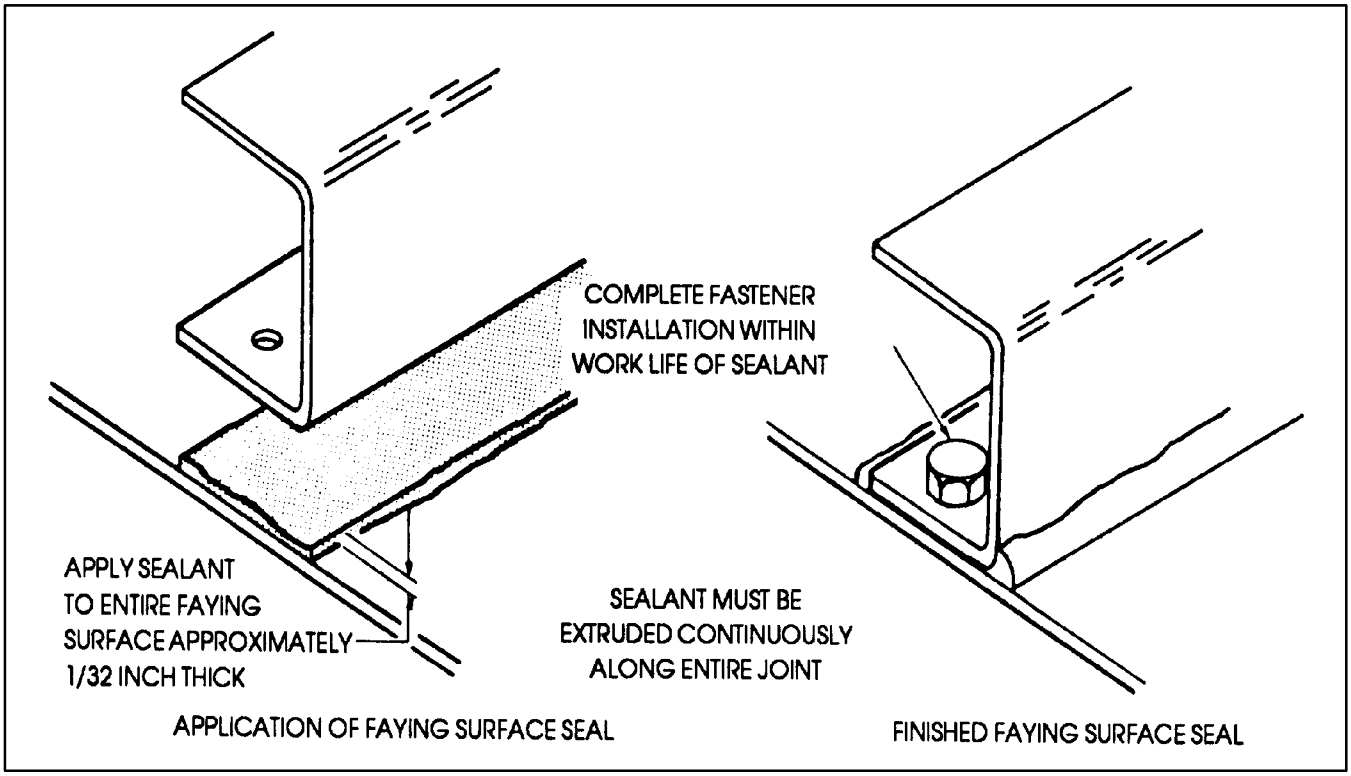


Figure 6-9. Faying Surface Sealing

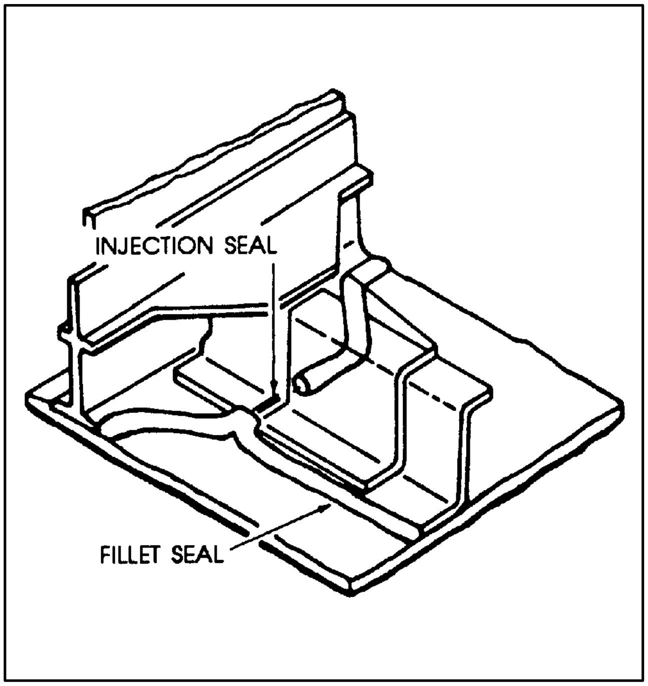


Figure 6-10. Typical Fillet Seal

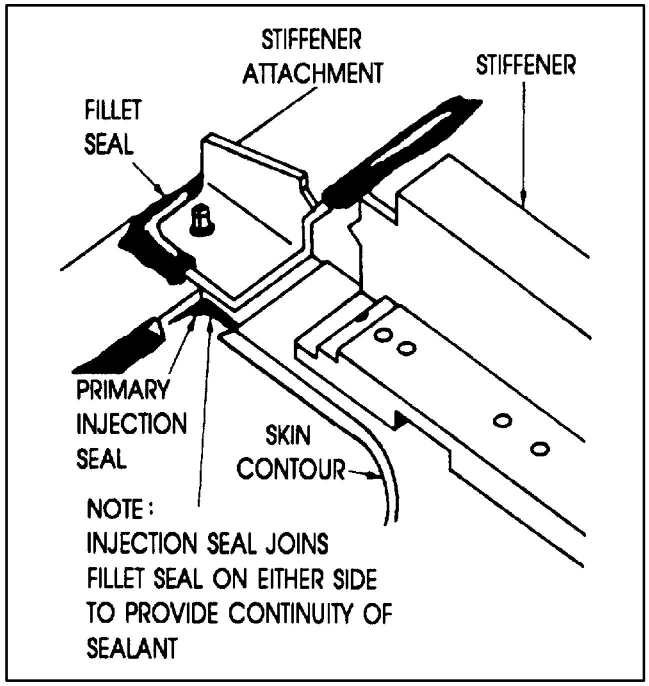


Figure 6-11. Typical Injection Seal

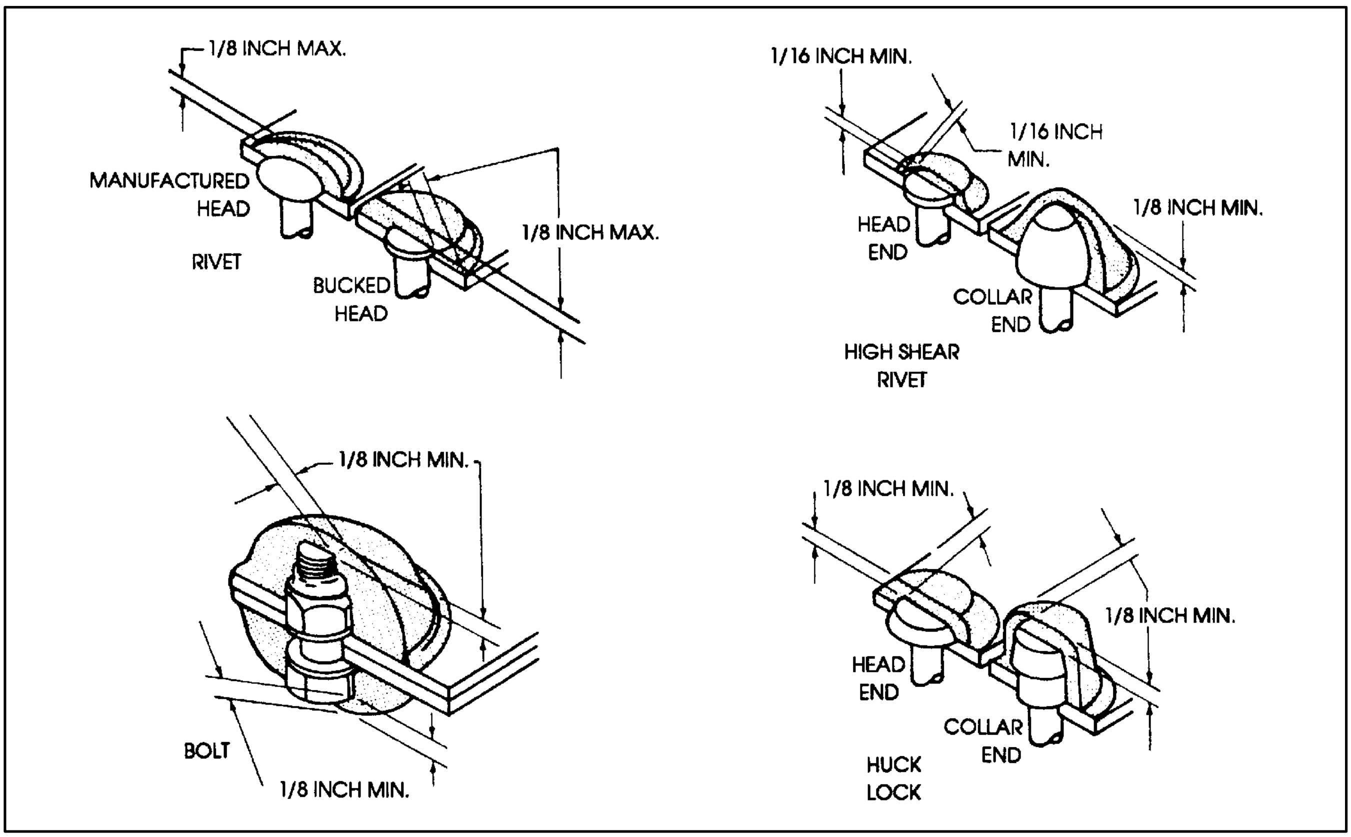


Figure 6-12. Typical Methods of Sealing Fasteners

d. Install new sealant tape so it overlaps the previously installed sealant by one–quarter to one–half of an inch on each side of the repair site.

NOTE

Ends of repair splice must overlap the existing sealant to ensure sealant integrity. Use care not to pull or stretch the ePTFE tape as it is applied. The stretched ePTFE tape will retract even if it is clamped between faying surfaces.

e. Once sealant tape is applied, run fingers back and forth on tape to further activate the adhesive.

NOTE

Applying extra pressure to the sealant tape will cause the pressure sensitive adhesive to better adhere to the faying surface and it will create indentations/discoloration at the fastener holes allowing for easy identification.

f. Puncture any affected fastener hole with a sharp pointed object such as an awl/scribe or scissors.

NOTE

As fasteners are installed, the ePTFE sealant material pushed into the fasteners will help seal against moisture intrusion.

g. Install access panel.

NOTE

No curing time is required. All fasteners should be wet installed with MIL–PRF–16173, Grade 4 Corrosion Preventive Compound (or equivalent as specified in each aircraft's maintenance manual.)

6–7.8. External aircraft structure. If, during normal maintenance, it becomes necessary to remove and replace components (wing planks, skin, spar caps, fasteners, fittings, etc.), they shall be sealed when reinstalled, even if they were not sealed originally. The only exception to this requirement is temporary repair accomplished for a one time flight to a depot or overhaul facility. See Figures 6–13 through 6–16 for typical methods.

6–7.9. Depressions. When the thickness of metal is reduced by more than 15 mils (0.015 inch) in the removal of corrosion damage, fill the depression with MIL–PRF–81733, Type II sealant after applying a chemical conversion treatment and priming with epoxy primer (MIL– P–23377).

NOTE

The above procedure does not apply to the use of ePTFE sealing tape or to the use of AMS–S–8802 sealant on the insides of integral fuel tanks.

6–7.10. Damaged sealant. Many areas on aircraft are now sealed either at the factory or by Depots during rework. Fresh sealant shall be applied whenever the previously applied sealant is damaged. Remove the damaged sealant with a plastic scraper and, if necessary, prepare the metal surface in accordance with Chapter 5, Section II. Slightly roughen a strip of the undamaged sealant approximately one inch wide around the boundary of the stripped area using an abrasive cloth and then clean with AMS 3166 solvent (or approved equivalent) using a clean cloth. Apply the new sealant by brush or spatula onto smaller areas or by spraying onto larger areas. The new sealant should overlap the existing coating onto the roughened area.

6–7.11. Extensive repair. If corrosion damage is so extensive that structural repair is necessary, all faying surfaces between patches (or doublers) and skins shall be painted with one coat of epoxy primer (MIL–P–23377). When the epoxy primer is dry, coat it with MIL–PRF–81733 sealant prior to installation of patch. Permanently installed fasteners shall be wet installed with MIL–PRF–81733 prior to installation. Removable panel fasteners shall be wet installed with P/N: PR–1773 (Air Force preferred) or AMS 3367.

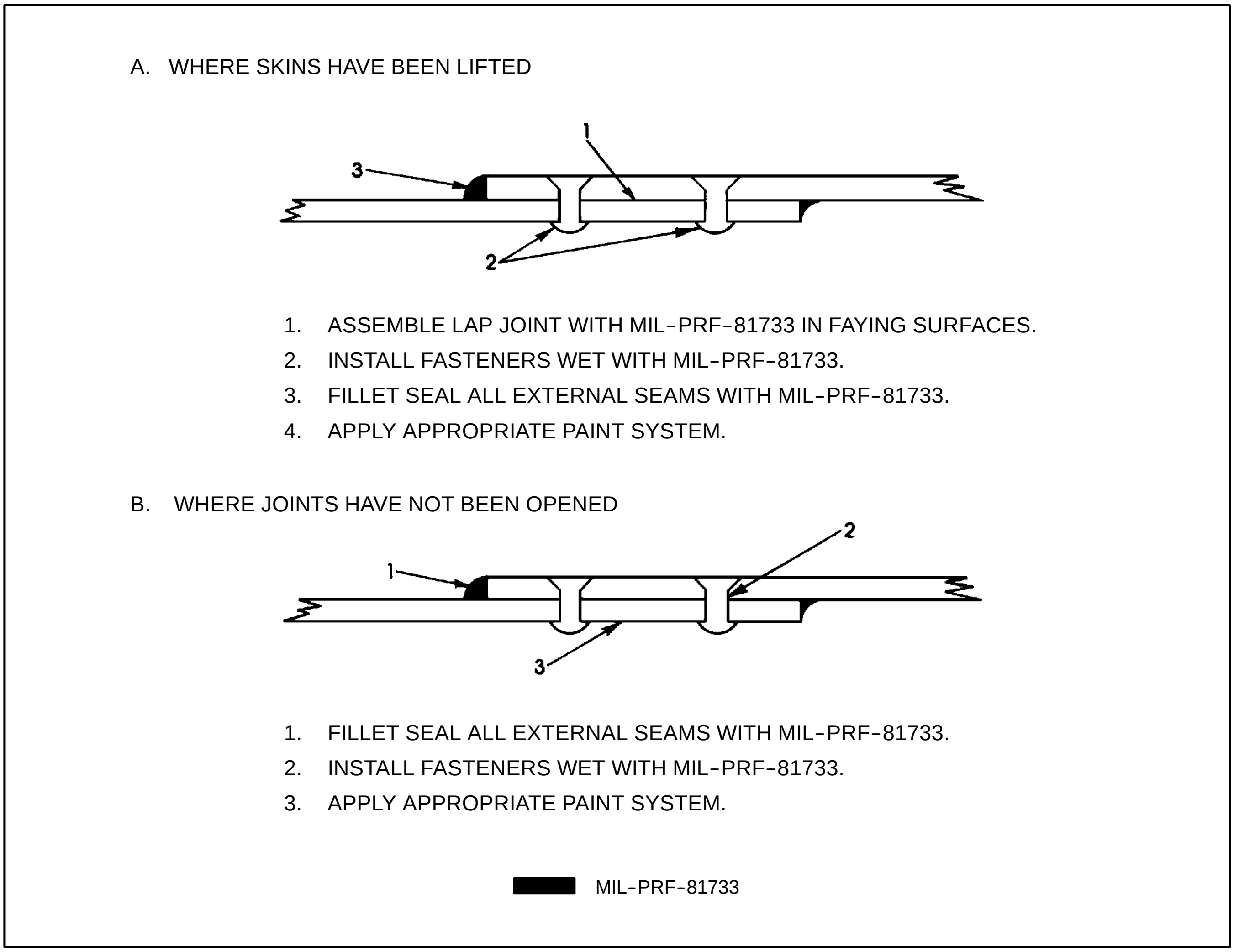


Figure 6-13. Typical Lap Skin Sealing

6-7.12. High temperature areas. In areas where the temperature is expected to rise above 250_F (121_C), a one-part silicone sealant, MIL-A-46146, Type I or AMS 3276 polysulfide sealant should be used. The application of the aforementioned sealants are very similar to spatula applied sealants, refer to paragraph 6-6.

6-7.13. Low temperature curing. When cold climates interfere with sealing operations by prolonging the sealant curing reaction, use MIL-S-85420 or AMS 3277. For better adhesion, an adhesion promoter can be used, refer to paragraph 6-3.3. ePTFE gasket material may be used in approved applications when low temperature sealing operations are required.

6-8. STORAGE OF SEALANTS. All sealants have a specified shelf life. The date of manufacture and the shelf life are listed on each container. The shelf life is dependent on storing the sealant in its original, unopened container in an area where the temperature does not exceed 80_F (27_C). Sealants shall not be stored in areas where the temperature exceeds 80_F (27_C). Prior to use, sealant containers shall be inspected to determine if the material has exceeded its shelf life. If a sealant has exceeded its original shelf life then it shall not be used until update testing has been performed. Procedures for the testing are given in the basic sealant specification. Sealants may be extended one-half of their original shelf life after passing the required tests. Updating may be repeated until sealant fails to pass testing. No sealant shall be used if it fails testing. Minimum update testing can be performed as follows:

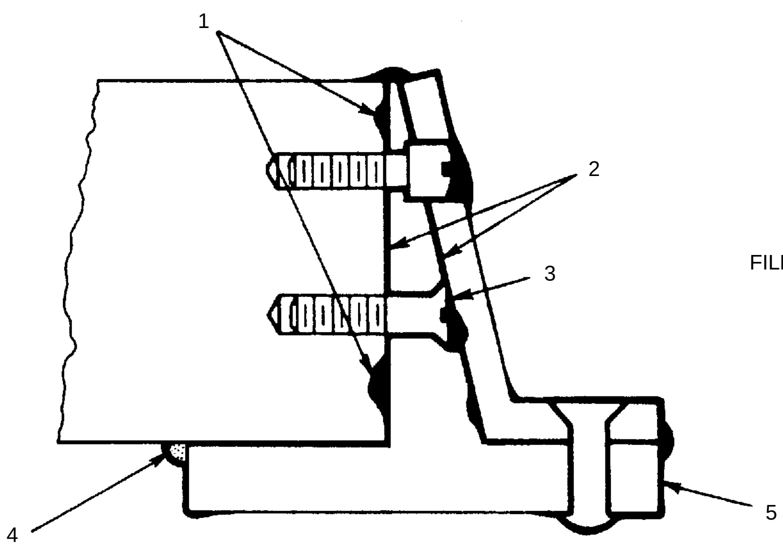
a. Select one kit of sealant from each manufacturer's batch of material to be tested for updating.

b. Visually examine the content of each can in the kit. If the base polymer is lumpy or partially cured or cannot be mixed with the curing agent, dispose of the opened kit and all kits from that batch of sealant.

c. If the kit can be blended to form a homogeneous mixture, determine whether the working time is suitable for the intended purpose by applying the mixture to a clean scrap metal. If the working time is not acceptable, dispose of the opened kit and all others from that batch.

d. If the working time is acceptable, the applied sealant shall be tested for cure time by periodically checking its hardness. The batch of sealant represented by applied sealant can be extended one-half its original shelf life if it achieves approximately the same hardness as sealant from kits which are not overaged.

e. This updating process may be repeated until the sealant fails to pass the above tests.



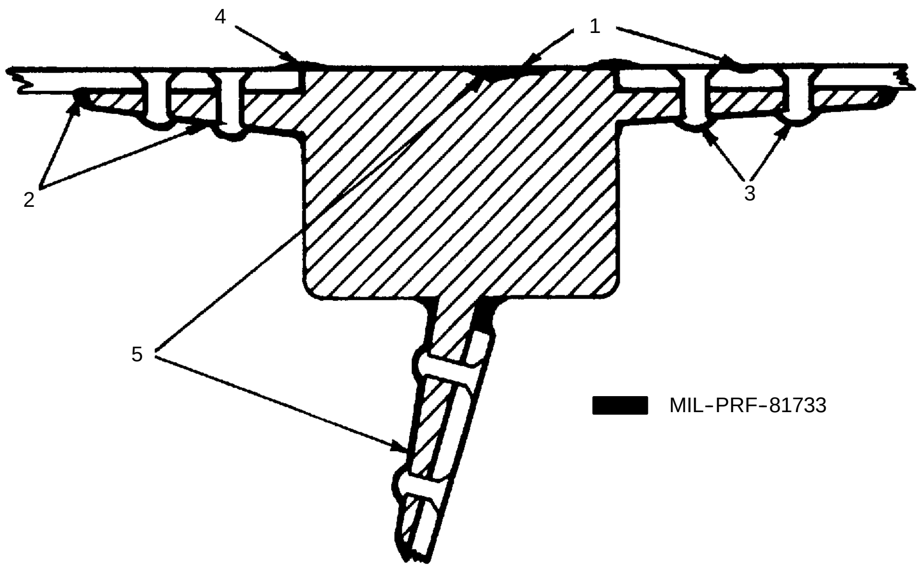
NOTE:

FILL ALL VOIDS

1. REMOVE CORROSION AND SURFACE TREAT IN ACCORDANCE WITH CHAPTER 5.
2. APPLY MIL-PRF-81733 SEALANT TO ALL FAYING SURFACES.
3. INSTALL ALL FASTENERS WET WITH MIL-PRF-81733.
4. FILLET SEAL ALL EXTERNAL JOINTS WITH MIL-PRF-81733.
5. COAT WITH APPROPRIATE PAINT SYSTEM.

MIL-PRF-81733

Figure 6-14. Sealing Procedures for Typical Aircraft Fitting



1. REMOVE CORROSION AND SURFACE TREAT IN ACCORDANCE WITH CHAPTER 5.
2. APPLY MIL–PRF–81733 SEALANT TO ALL ACCESSIBLE FAYING SURFACES.
3. INSTALL ALL FASTENERS WET WITH MIL–PRF–81733.
4. FILLET SEAL ALL EXTERNAL SEAMS WITH MIL–PRF–81733.
5. COAT ENTIRE SPAR CAP AND FASTENER AREA WITH MIL–PRF–81733, FILLING ALL DEPRESSIONS.
6. COAT WITH APPROPRIATE PAINT SYSTEM.

Figure 6–15. Typical Spar Cap Sealing

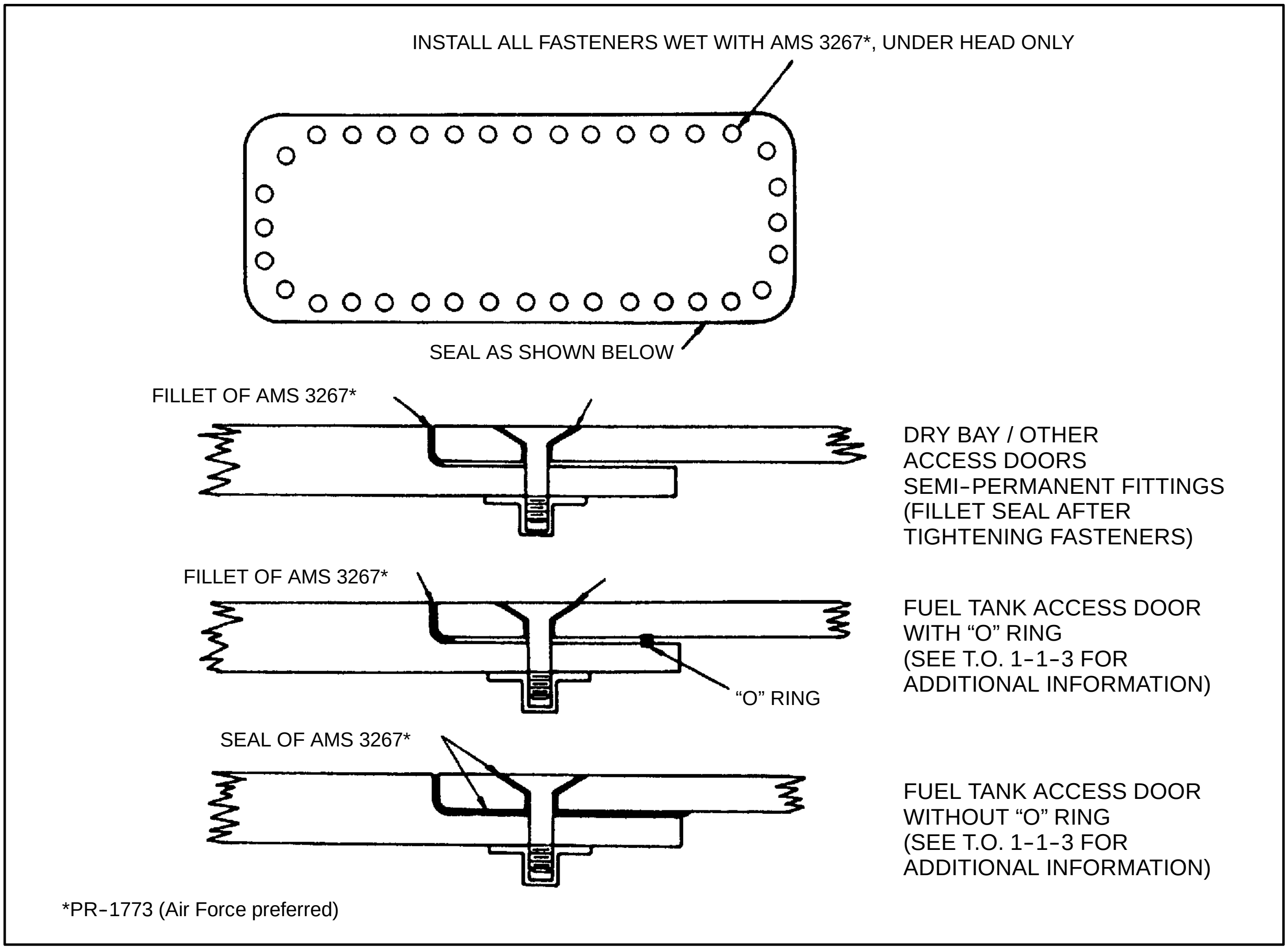


Figure 6–16. Sealing of Access Doors

CHAPTER 7

PAINT FINISHES AND TOUCH–UP PROCEDURES (NAVY AND MARINE CORPS ONLY)

7–1. SCOPE. This chapter describes materials and procedures used for applying protective paint finishes to interior and exterior surfaces of Navy and Marine Corps aircraft. This information is intended for use in conjunction with system specific paint finishing instructions. Refer to T.O. 1–1–4 and T.O. 1–1–8 for Air Force paint finishes and procedures. Refer to TM 55–1500–345–23 for Army paint finishes and procedures. This chapter describes the following:

a. Safety precautions when storing and handling paint materials;

b. Paint material storage and shelf life considerations;

c. Paint systems used on Navy and Marine Corps aircraft;

d. Paint application equipment;

e. Preparation of surfaces prior to painting;

f. Paint application techniques; and

g. Specific mixing and application information for standard paint finishing materials.

7–2. SAFETY. Paint materials, including primers and solvents, are toxic and flammable. It is essential to properly store, handle, and apply these materials to prevent fires and to minimize exposure to solvent vapors and paint overspray mist. All personnel involved with paint operations shall read, understand, and follow OPNAVINST 5100.23 and A1–NAOSH–SAF–000/P–5100–1. Consult the local Occupational Safety and Health Office or Industrial Hygiene Activity for these references and appropriate safety precautions pertinent to specific sites. Consult applicable material safety data sheets (MSDSs) supplied by the manufacturer for information on specific material hazards. Additional safety information may be obtained from the Hazardous Material Users Guide (HMUG) and DOD 6050.5–LR.

7–2.1. Respirator use. Respiratory protection programs shall be established per OPNAVINST 5100.23. Whether painting operations are performed indoors or outdoors, it is necessary to avoid inhalation of vapors and dust. Solvents and thinners used for paint processes, including those used for equipment cleanup, are harmful if inhaled for prolonged periods and should be handled with the same care as paint materials. Contact the local Industrial Hygiene Activity or Occupational Safety and Health Office for proper selection of respiratory protection equipment. Refer to Appendix B for detailed specifications of various respirators and supplied air devices.

7–2.2. Protective clothing. Eye and skin contact with paint materials and solvents shall be avoided. Wear protective goggles or face shield, rubber gloves, and coveralls. If paint materials or solvents contact the eyes, rinse with fresh water for 15 minutes and seek immediate medical attention. If contact with the skin occurs, wash affected area with soap and water; if there is excessive exposure or a severe reaction, seek medical attention immediately.

7–2.3. Ventilation. Adequate ventilation shall be provided in all painting and storage areas to prevent the build-up of solvent vapors. Painters and all other personnel involved in the paint operation shall take appropriate precautions to minimize exposure to solvent vapors and paint overspray mist.

7–2.4. Fire prevention. Paint materials are extremely flammable. These materials shall be stored, mixed and applied in approved areas away from heat, flame, sparks, and other sources of ignition. Ensure that fire fighting equipment is readily available and in working order. Consult the local Fire Department, Fire Marshall, or Occupational Safety and Health Office for specific fire prevention and safety requirements during painting operations.

7–3. STORAGE AND SHELF LIFE. All paint materials shall be stored in tightly closed containers away from excessive heat and cold. As a general rule, store paint materials between 40_F and 100_F, away from direct sunlight.

Extreme storage temperatures will reduce the effective shelf life of paint materials.

7-3.1. Identification. All paint materials shall be properly identified when stored. Containers should be relabeled when necessary to ensure legibility. Previously opened containers shall be closed and sealed tightly. Paint thinners shall be stored with the same care as paints.

7-3.2. Shelf life. The shelf life or storage life of different paint materials can vary from several months to several years. The manufacturer's recommended shelf life is usually printed on the container label. However, if properly stored, material usability often exceeds these recommendations. Shelf life information may also be obtained from the applicable material specification and NAVSUP 4105.

7-3.3. Shelf life extension. If the shelf life of the material is exceeded, shake the container, or containers as in the case of multi-component paint materials, and examine the contents. The material shall be homogenous with no skinning and lumps. The resin component of multi-component materials shall be clear with no visible cloudiness, white precipitate, or sediment. Containers shall be free from rust. Discard any unsuitable materials according to local regulations. If the material appears satisfactory, mix and apply it to test specimens. Periodically check the coating on the test specimens for appropriate drying and film characteristics. If the material dries properly, the shelf life may be extended for a period of 6 months. If the coating does not dry in the specified time, dispose of the material according to local regulations. Shelf life for paint-type materials can be extended two times if the material is found suitable, for a total extension period of 12 months. Shelf life action codes determine the length of original shelf life and the type of action to be taken at the end of that period. Each fleet industrial supply center (FISC) has a shelf life coordinator that can assist in resolving shelf life issues.

7-4. PAINT SYSTEMS. The primary objective of any paint system is to protect exposed surfaces against corrosion and other forms of deterioration. Operational uses for particular paint schemes include:

a. Glare reduction by flat (lusterless or non-specular) coatings;

b. Special finishes for reduction of heat absorption;

c. Camouflage and other detection countermeasures;

d. High visibility requirements; and

e. Identification markings.

7-4.1. Paint system materials. Aircraft paint systems usually consist of a primer and topcoat combination applied over a properly prepared surface. The primer contains corrosion inhibitors and also promotes adhesion of the paint system. The primer may also provide low infrared reflectance properties. The topcoat provides durability to the paint system, including weather and chemical resistance, along with coloring necessary for tactical requirements. Self-priming topcoats (SPT) combine the properties of both primer and topcoat into one coating. On some aircraft, spray sealant is applied between primer and topcoat to improve paint system flexibility.

7-4.1.1. Environmentally compliant coatings. The Environmental Protection Agency (EPA), along with many local and state air pollution control districts, has implemented rules which limit the volatile organic compound (VOC) content, or solvent content, of paints applied to aircraft. VOC content is reported as grams of solvent per liter of paint or "G/L". Currently, the national maximum permissible VOC content is 340 G/L for aircraft primers, and 420 G/L for aircraft topcoats, including self-priming topcoats. These limits may be less in certain local or state air pollution control districts. It is the responsibility of the user activity to ensure that applicable rules are understood and obeyed. Failure to comply with current rules can result in large fines and revocation of air emission permits. Consult the local Environmental Affairs Office or appropriate permitting authority for guidance.

7-4.1.2. Common materials. Table 7-1 lists the primary coatings used on Navy and Marine Corps aircraft and some specific material characteristics.

Table 7–1. Primary Coatings Used on U. S. Navy and Marine Corps Aircraft

Specification	Material Designation	VOC, G/L (Max)	Typical Dry Film Thickness (Mils)
MIL–P–23377	Epoxy Primer, High–Solids	340	0.6 – 0.9
MIL–PRF–85582	Epoxy Primer, Waterborne	340	0.6 – 0.9
TT–P–2760	Polyurethane Primer, Elastomeric	340	1.5 – 2.0
MIL–PRF–85285, Type I	Polyurethane Topcoat, High–Solids	420	1.7 – 2.3
TT–P–2756	Polyurethane Topcoat, Self–Priming	420	2.0 – 2.6
MIL–PRF–22750	Epoxy Topcoat, High–Solids	340	1.7 – 2.3

7–4.2. Paint colors. FED–STD–595 (color fandeck) provides a list of paint colors represented in five–digit numbers. The first digit describes gloss value: 1 = high gloss, 2 = semi–gloss, and 3 = flat (lusterless). The second digit describes the color family: 0 = browns, 1 = reds, 2 = oranges, 3 = yellows, 4 = greens, 5 = blues, 6 = grays, 7 = blacks, whites, and metallics, and 8 = fluorescent. The remaining three digits describe the color value or hue. For example, color number 36440 is a flat, gray color and color number 17925 is a high gloss, white color. See Appendix B for ordering information of the color fandeck.

7–4.3. Paint system identification. Paint finish materials, application date, and application activity are identified by decal or stencil located on the aft starboard side of the aircraft fuselage, and should be used as a guide for selection of materials when paint system repair is necessary. Refer to MIL–STD–2161 and system specific instructions for paint color schemes, aircraft markings/MODEX, and specific material requirements.

7–4.4. Touch–up. For touch–up painting, brush or roller application shall be used to the maximum extent possible to minimize paint waste. Spray painting is more labor intensive and produces a large quantity of waste from paint mixing, overspray, and paint equipment cleanup. Disposable acid brushes, touch–up pens, and rollers are efficient and inexpensive for touch–up purposes. Table 7–2 lists original coatings materials and specified touch–up materials used for common aircraft paint systems. All activities shall be familiar with paint scheme requirements, particularly the importance of using appropriate materials. Refer to MIL–STD–2161 and system specific instructions for paint finishing details.

7–4.5. Cosmetic painting. Repainting solely for the sake of cosmetic appearance shall be avoided. Since common paint materials may take as many as seven days to completely cure, a faded or stained but well–bonded paint finish is more durable than a fresh touch–up treatment. Refinishing shall be performed only when existing paint finishes have deteriorated or have been damaged, or when removal of the existing paint system is necessary for corrosion corrective actions.

7–4.6. Temporary markings. Where local environmental regulations permit, lacquer paint such as MIL–PRF–81352, Type I or A–A–665 (aerosol enamel) may be used for temporary markings. Lacquer can be easily removed using a solvent such as MIL–T–81772, Type I Aircraft Paint Thinner or TT–T–2935 without affecting the underlying paint system. In instances where local environmental regulations do not permit the use of lacquer, use only the prescribed environmentally compliant coatings listed in Table 7–2.

Table 7–2. Original Coating Systems and Corresponding Touch–up Systems

Paint System and Description	Original Coatings	Touch–up Coatings
TACTICAL PAINT SCHEME or LAND CAMOUFLAGE PAINT SCHEME: A color scheme designed for specific aircraft types to reduce visual detection by matching the reflectance of operational surroundings. Tactical paint schemes are comprised mainly of flat gray colors (35237, 36081, 36118, 36320, 36231, 36375, or 36495). Land camouflage paint schemes are comprised of flat green (34095), gray (36375), and black (37038).	Primer MIL–P–23377 Type II or MIL–PRF–85582 Type II Topcoat MIL–PRF–85285 Type I or TT–P–2756	Primer MIL–P–23377 Type II or MIL–PRF–85582 Type II Topcoat MIL–PRF–85285 Type I, MIL–PRF–22750, or TT–P–2756
HIGH GLOSS PAINT SYSTEM. The traditional, highly reflective glossy paint scheme, usually composed of insignia white (17925), and gull gray (16440), with other colors and markings.	Primer MIL–P–23377 Type I, MIL–PRF–85582 Type I, or TT–P–2760 Topcoat MIL–PRF–85285 Type I or TT–P–2756	Primer MIL–P–23377 Type I, MIL–PRF–85582 Type I, or TT–P–2760 Topcoat MIL–PRF–85285 Type I, MIL–PRF–22750, or TT–P–2756
INTERIOR SURFACES (NO TOPCOAT). Many hidden, interior surfaces do not require protective topcoats since they are not exposed to direct sunlight, heavy soils, or overly corrosive conditions.	Primer MIL–P–23377 Type I, MIL–PRF–85582 Type I, or TT–P–2760	Primer MIL–P–23377 Type I, or MIL–PRF–85582 Type I TT–P–1757 is not authorized for use on this application
INTERIOR SURFACES (WITH TOPCOAT). Many interior surfaces require a topcoat due to operational necessity. This includes surfaces requiring frequent cleaning and additional corrosion protection.	Primer MIL–P–23377 Type I, MIL–PRF–85582 Type I, or TT–P–2760 Topcoat MIL–PRF–85285 Type I, MIL–PRF–22750, or TT–P–2756	Primer MIL–P–23377 Type I, or MIL–PRF–85582 Type I Topcoat MIL–PRF–85285 Type I, MIL–PRF–22750, or TT–P–2756

7–4.7. Aerosol coatings. Conventional aerosol coatings do not provide adequate corrosion protection, weather resistance, and durability, nor are they resistant to operational fluids. Aerosol coatings are not authorized for aircraft touch–up except for application of temporary markings per paragraph 7–4.6. Refer to Table 7–2 for a list of standard authorized touch–up materials.

7–4.8. Wet installations. Waterborne materials, such as MIL–PRF–85582 Waterborne Epoxy Primer, shall not be used for wet installation of fasteners and bushings since entrapped moisture may promote corrosion of the fasteners or components. In general, MIL–P–23377 Epoxy Primer and MIL–PRF–81733 Polysulfide Sealant are preferred materials for wet installation purposes. Consult specific maintenance instructions for appropriate selection of materials.

7–4.9. Special surfaces. Some aircraft surfaces require specialized coatings to satisfy service exposure and operational needs. Radomes, antenna covers, and parts with similar elastomeric coatings shall be repaired in accordance with NAVAIR 01–1A–22 and system specific repair instructions. Touch–up of propeller blades, helicopter rotor blades, leading edge erosion resistant coatings, and anti–chafe coatings shall be performed in accordance with system specific repair instructions. Refer to NAVAIR 16–1–540 for touch–up of avionics equipment. Refer to NAVAIR 17–1–125 for touch–up of ground support equipment.

7–5. PAINT EQUIPMENT. Paint coatings are typically applied using brushes, touch–up pens, rollers, and spray guns. Selection of an appropriate application method depends upon the size of the area to be painted, where the paint is to be applied, and what equipment is allowed. Specific coating application procedures are controlled by environmental and safety regulations, and some equipment may be prohibited. Therefore, anyone performing painting operations shall be knowledgeable about local, state, and federal regulations governing equipment and procedures. Consult the local Environmental Affairs Office for specific requirements.

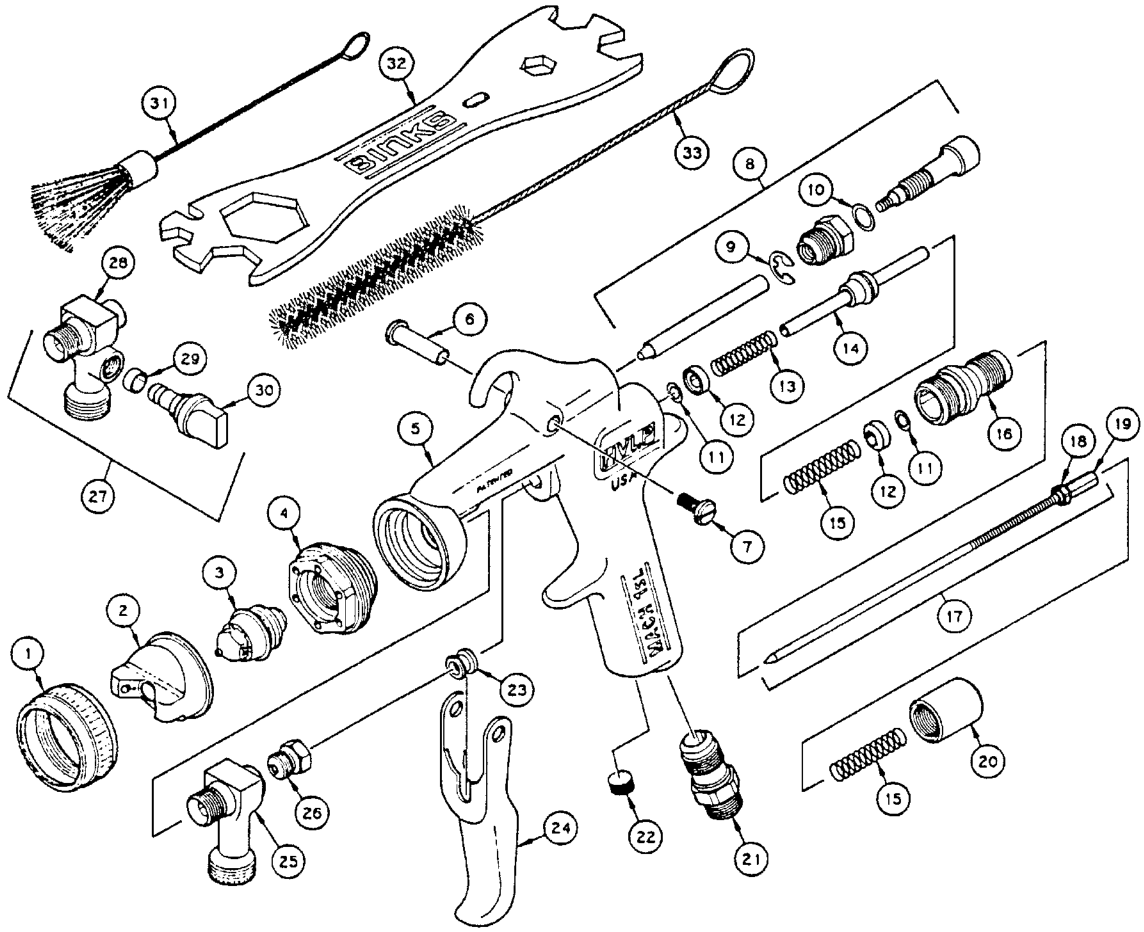
7–5.1. Transfer efficiency. Application methods shall be selected to minimize the amount of paint waste and solvent emissions. Transfer efficiency is used to gage the effectiveness of paint equipment and is represented as a percentage of the amount of paint deposited on the surface compared with the total amount of paint used. Spray painting produces overspray and has much less transfer efficiency than brush or roller application. The EPA has established specific requirements for paint spray equipment used on aircraft surfaces. High volume low pressure (HVLP) spray equipment or electrostatic spray equipment are recommended since they have transfer efficiencies of 65 percent or better. Conventional high pressure spray equipment has a transfer efficiency of approximately 35 percent and is no longer allowed in most localities for use on aircraft surfaces. Consult the local Environmental Affairs Office for guidance on selection of proper paint spray equipment.

7–5.2. High Volume Low Pressure (HVLP) equipment. HVLP spray equipment atomizes paint into a soft pattern of low speed particles using an air cap pressure up to 10 psi maximum. Due to the low velocity of the coating particles, more of the coating is deposited on the intended object with less overspray. Since there is less overspray, it is easier to see the surface being coated. Film build is faster than with conventional spray equipment due to higher transfer efficiency. Benefits include less material usage and less paint booth maintenance due to less overspray. The proper working distance of an HVLP gun is usually closer than with a conventional paint spray gun. Due to environmental regulations, an HVLP system must not be operated at air cap pressures exceeding 10 psi. Refer to manufacturer's literature supplied with the paint gun for proper operation and adjustment. Figure 7–1 illustrates the components of a typical HVLP paint spray gun. Refer to Appendix B for ordering information of the HVLP paint spray gun.

7–5.2.1. HVLP equipment options. HVLP spray guns are suitable for painting both large areas and small components. These guns can be fitted with a small cup, usually a pint or quart capacity, or to a pressure pot. A pressure pot holds two or more quarts of paint and is pressurized to force paint through a hose to the paint spray gun. The amount of pressure supplied to the pot is determined by the paint viscosity and length of paint supply hose. Follow manufacturer's recommendations to set pot pressure.

7–5.3. Electrostatic equipment. Electrostatic paint spray equipment deposits paint on surfaces by means of static electrical attraction. The surface to be painted and the coating material have opposing charges which causes the coating to be attracted to the surface. Electrostatic painting is useful for painting large areas and, if used properly, produces little overspray with high transfer efficiency. Due to electrical conductivity requirements, this equipment is highly dependent upon the type of coating (i.e., waterborne vs. solvent based) and substrate conditions (i.e., metallic or nonmetallic). Follow manufacturer's recommendations and safety precautions when operating this equipment.

7–5.4. Touchup spray gun. A touchup spray gun is used to apply paint to small areas using a small spray pattern. Since these guns are used for small areas, they are often acceptable under environmental regulations. Consult the local Environmental Affairs Office for guidance on the use of touchup spray guns.



PARTS LIST

ITEM NO.	DESCRIPTION	QTY.
1	RETAINER RING	1
2	AIR NOZZLE	1
3	FLUID NOZZLE	1
4	HEAD INSERT	1
5	GUN BODY ASSEMBLY	1
6	TRIGGER STUD	1
7	TRIGGER SCREW	1
8	SIDE PORT CONTROL ASS'Y	1
9	RETAINING RING	1
10	O-RING	1
11	O-RING	2
12	SEAL RETAINER	2
13	SPRING	1
14	SPINDLE ASS'Y	1
15	SPRING	2
16	HOUSING	1
17	NEEDLE ASS'Y	1
18	NEEDLE LOCKNUT	1
19	NEEDLE CAP	1
20	MATERIAL VALVE CONTROL KNOB	1
21	AIR CONNECTION	1
22	PLUG, 1/8" NPT	1
23	VALVE SPINDLE CAP	1
24	TRIGGER	1
25	FLUID INLET	1
26	SEAL CARTRIDGE ASS'Y	1
27	ADJUSTABLE FLUID INLET ASS'Y	1
28	FLUID INLET	1
29	PACKING SEAL	1
30	SPINDLE ASSEMBLY	1
31	GUN BRUSH	2
32	WRENCH	1
33	GUN BRUSH	1

Figure 7-1. Typical HVLP Spray Gun

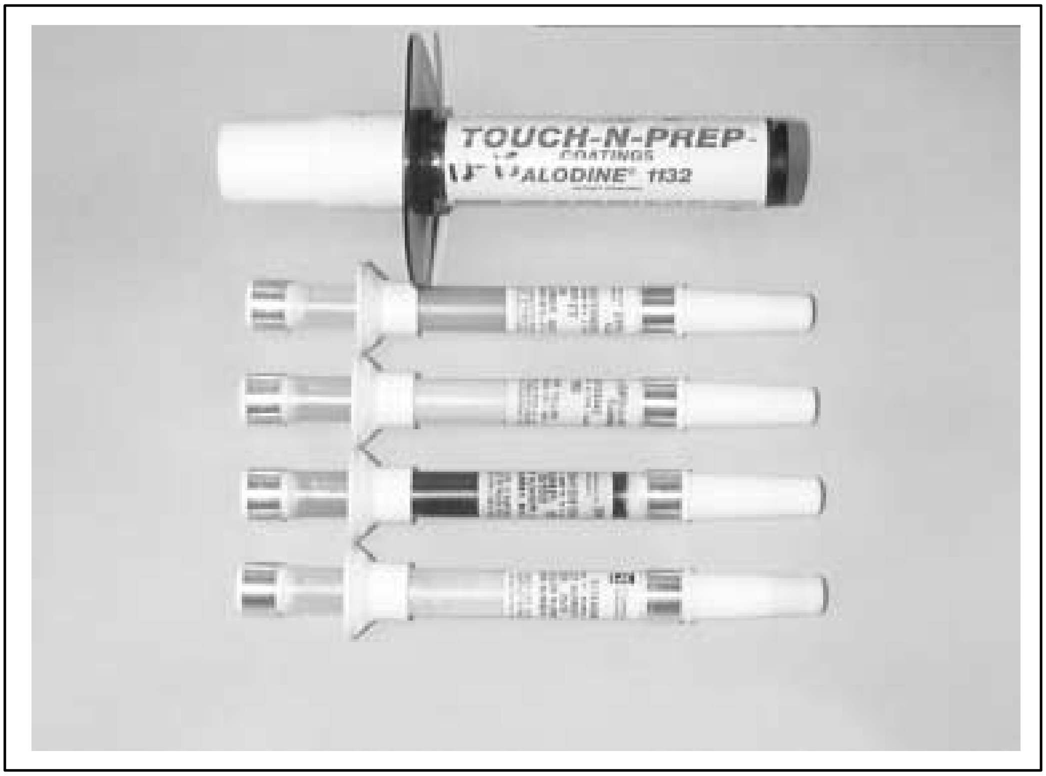


Figure 7–2. Touch–N–Prep Pen t and Sempens t

7–5.5. Brush and roller. Brushes and rollers are alternatives for touch–up painting. They must be constructed of durable materials that will not be affected by solvents in the coatings and should only be used once. Use the brushes and rollers specified in Appendix B. Note that in addition to the standard 1” wide brush, there is an “artist brush” available for hard to reach areas. Use rollers with the shortest nap possible in order to achieve the best surface finish. Do not use disposable foam brushes or foam rollers since they are not solvent resistant.

7–5.6. Chemical Conversion coating pen. Touch–N–Prep t (TNP) pens are available to apply chemical conversion coatings per MIL–C–81706 to aluminum surfaces prior to priming and painting (see Figure 7–2). The ordering information for the pens (Alodine 1132) is listed in Appendix A.

7–5.6.1. Surface preparation. Before using the TNP pens, the following surface prepration is necessary:

a. Cleaning. Clean the bare aluminum surfaces with a 10% aqueous solution of MIL–PRF–85570, Type II followed by a water rinse.

b. Removing Oxides. Abrade the surface to remove light oxidation with aluminum oxide abrasive mats (A–A–58054). Keep the suface wet with clean water while abrading. Immediately wipe the abraded surface with a clean cloth soaked in clean water to remove oxides and nylon residue. Repeat this last step with a new, wet cloth until the cloth remains clean. Check for a water–break free surface with clean water (repeat abrasion steps if test fails). Do not allow the surface to dry before applying the conversion coating, or oxides may form and prevent a proper conversion reaction with the aluminum.

7–5.6.2. Conversion coating with Touch–N–Prep t (TNP) pens.

a. To use the TNP pen, remove the cap and charge the tip by pushing it against a firm surface for 10 – 15 seconds. The conversion coating solution will saturate the tip.

b. Immediately apply Alodine 1132 using the TNP pen in parallel strokes that overlap about 50%. Allow the first coat to dry for 5 - 10 minutes.

c. Apply a second coat perpendicular to the first coat and allow it to dry.

CAUTION

Do not rinse this coating. It is ready for priming and top coating. The as-applied coating is soft and easily removed when rubbed. It will harden and toughen after one hour of drying time.

7-5.7. Touch-up pen. MIL-P-23377 High-Solids Epoxy Primer, MIL-PRF-85582 Waterborne Epoxy Primer, and MIL-PRF-85285, Type I High-Solids Polyurethane Coatings are available in touch-up pens (Figure 7-2). These self-contained touch-up applicators are available by national stock numbers (refer to Appendix A for stock ordering information). The applicator is designed for convenient storage, mixing, and application of pre-measured two-component coating materials, and is ideal for touch-up of small areas where spraying is impractical or not allowed. Each applicator contains 10 milliliters (1/3 fluid ounce) of material and will cover an area of approximately 1 to 2 square feet. The two components are separated by a barrier (see Figure 7-3). The material is mixed and applied as follows:

a. Before mixing, ensure the applicator is at room temperature. Read and follow manufacturer's information, including MSDS, supplied with the applicator.

b. Slide the collar all the way to the back of the applicator to displace the barrier between the two components. See Figure 7-4.

c. With the brush cap in place, shake the applicator vigorously by hand until the two components are thoroughly mixed (approximately one minute).

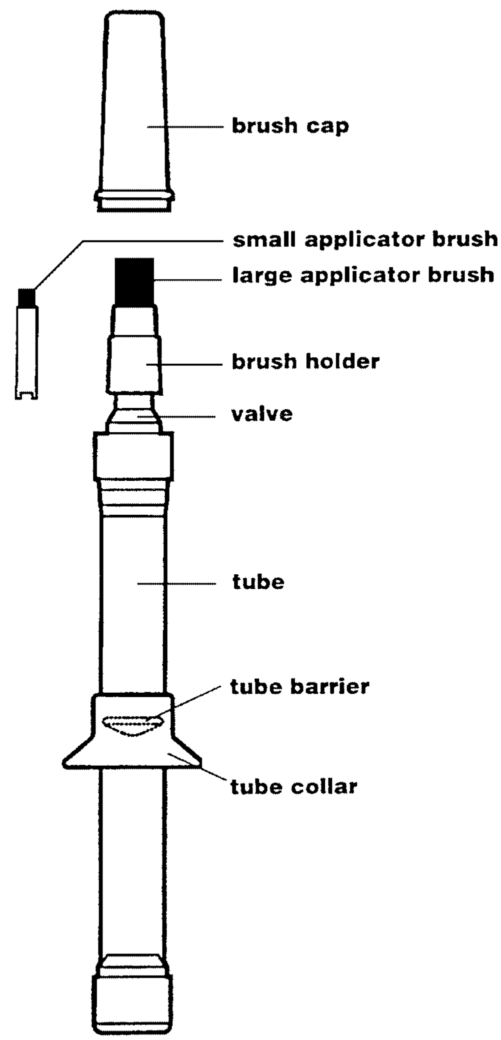


Figure 7-3. Touch-up Pen (Sempen t)

d. After mixing, remove the brush cap and press the applicator against a scrap surface to bleed off any internal pressure that may have formed during storage. Make sure the applicator is not pointing toward anyone.

e. Depress the applicator brush against the work surface. This opens the spring-loaded valve that allows the coating material to flow when the tube is gently squeezed. Use the brush to apply a uniform coating to the surface. See Figure 7-5.

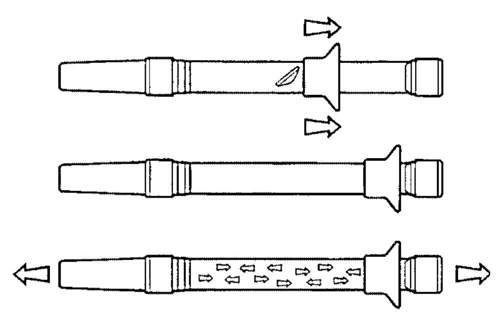


Figure 7-4. Touch-up Pen (Sempen t) Mixing

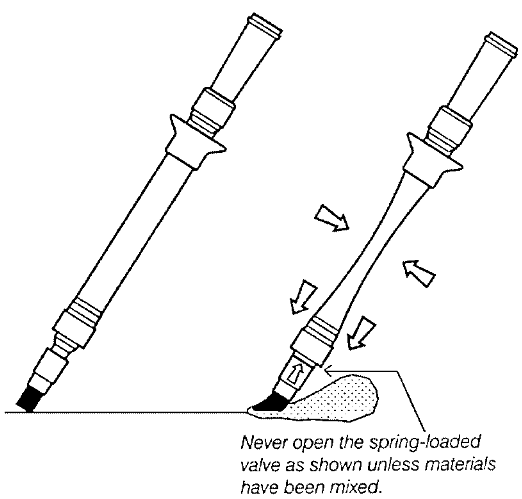


Figure 7-5. Touch-up Pen (Sempen t) Application

f. Replace the brush cap when the applicator is not being used. The useful pot life of the mixed material is approximately 8 hours. Do not store the applicator in a shirt pocket or any other clothing article.

g. Follow manufacturer's instructions for changing brushes. Only change brushes after the material in the applicator has been mixed.

7-5.8. Viscosity check, Zahn Number 2 Cup. Viscosity of paint materials can be obtained by measuring the time required for the material to flow from a cup with a specified volume through a specified orifice size in the bottom of the cup. A Zahn No. 2 cup is constructed of corrosion resistant steel. This cup will hold 44 milliliters (1.47 ounces) of material and has a calibrated orifice in the bottom. The cup must not be damaged or altered to ensure consistent volume; the size of the orifice must also remain the same. Do not use abrasive materials or metallic objects to clean the cups since damage to the volume or orifice may occur. Viscosity is measured using the Zahn No. 2 cup as follows (see Figure 7-6):

a. Prepare the material to be tested. Mix and strain per manufacturer's recommendations.

b. Fill the cup by submerging it into the material. Make sure that enough material is available to completely fill the cup.

c. When the cup is full, raise it completely out of the material and immediately start a stopwatch. Carefully observe the flow of paint from the orifice.

d. When the constant stream or flow of the material breaks, stop the watch. The time required (in seconds) for the stream to break is the viscosity value. Viscosity values will vary among coatings. Primers are usually applied at lower viscosities (15-25 seconds), and topcoats such as MIL-PRF-85285 or TT-P-2756 materials are usually applied at higher viscosities (18 - 30 seconds). Refer to the application instructions for specific coating requirements. To avoid exceeding VOC limits, do not add additional paint thinner unless specifically authorized per manufacturer's instructions.

7-5.9. Wet film thickness gage. Wet film thickness of coatings is used to estimate the dry film thickness. Wet film thickness is easily obtained using a comb-type thickness gage. Refer to Figure 7-7. As a general rule, dry film thickness will be approximately 50 percent of the wet film thickness. Wet film thickness is obtained as follows:

a. Place gage on wet film at 90_ angle. This is done on test panels sprayed at the same time as the actual component or on masking tape adjacent to the actual component just after the coating is applied.

b. Press into film. Withdraw and note deepest tooth having paint on it and next higher tooth that is not coated.

c. The wet film thickness lies between these two readings.

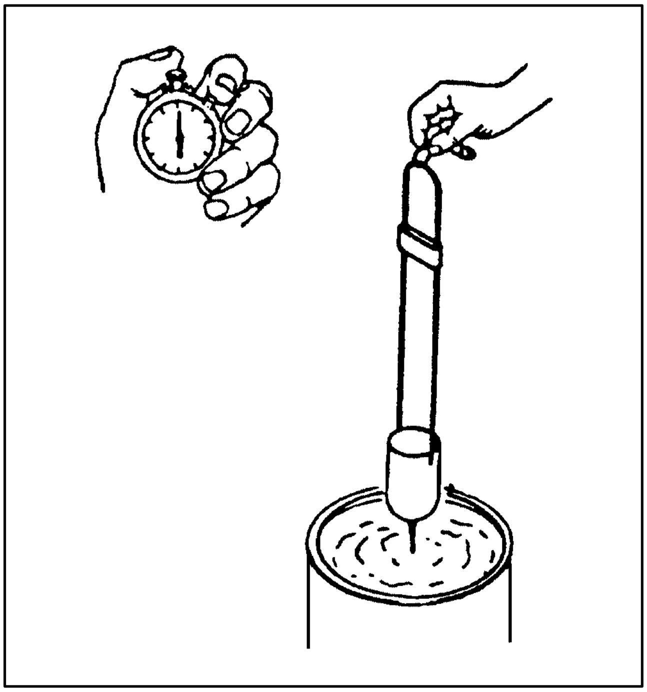


Figure 7–6. Using Zahn Viscosity Cup

d. Clean gage in a suitable solvent immediately after use.

7–6. GENERAL MAINTENANCE REQUIREMENTS FOR PAINT SPRAY EQUIPMENT. Proper maintenance is necessary to preserve the life of the paint spray equipment and ensure high quality results. The spray gun requires little maintenance if kept clean. Two–part catalyzed coatings cure or harden by chemical reaction in addition to solvent evaporation. The curing process begins when the two components are mixed. Over a few hours, the coating will gel and harden regardless of whether or not it is exposed to air. If catalyzed materials are allowed to remain in the equipment too long, the equipment will become inoperative. For this reason, paint equipment shall be thoroughly cleaned immediately after use or at least every two hours.

7–6.1. Paint equipment cleaning processes. Paint spray equipment clean–up procedures are controlled by EPA regulations. Local and state pollution control districts may also have specific requirements. Consult the local Environmental Affairs Office for specific requirements. Generally approved cleaning solvents and methods are listed below.

7–6.1.1. Equipment cleaning solvent. To effectively remove residue, paint equipment cleaning solvents must be compatible with the type of coating material. In general, residue from polyurethane coatings such as MIL–PRF–85285, TT–P–2756, and TT–P–2760 can be removed using MIL–T–81772, Type I Thinner or TT–T–2935. Residue from epoxy coatings such as MIL–C–22750 and MIL–P–23377 can be removed using MIL–T–81772, Type II Thinner or TT–T–2935. Uncured residue from waterborne coatings such as MIL–PRF–85582 can be removed using a combination of water and TT–I–735 (Isopropyl Alcohol). To prevent corrosion, do not allow water to remain in the paint equipment.

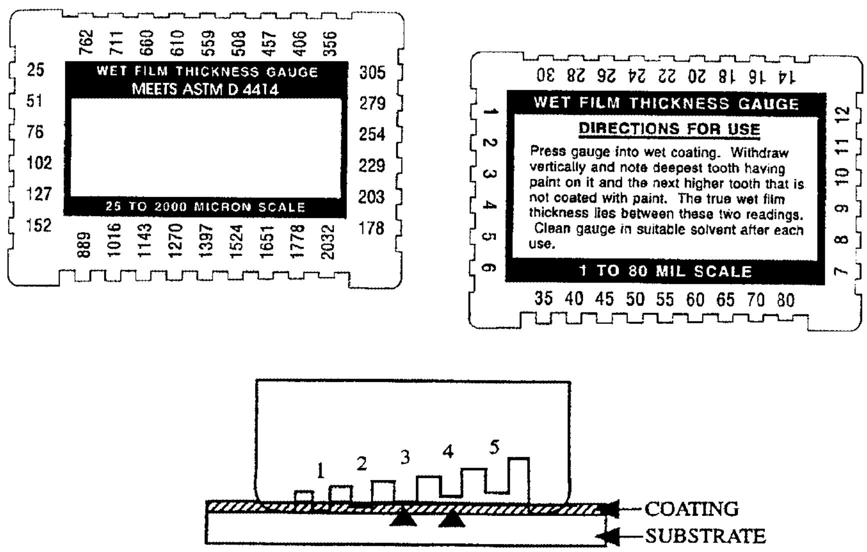
WARNING

Rags and other cleaning materials saturated with waste solvent are a potential fire hazard and therefore shall be deposited in a suitable container immediately after use. The container shall be covered with a tight fitting lid and kept closed except when depositing or removing cleaning materials.

7–6.1.2. Enclosed system. A cabinet–type paint gun washer system, such as that listed in Appendix B, or other suitable system which can recover at least 85 percent of the cleaning solvent is generally suitable for regulated areas. These systems shall be operated and serviced per manufacturer’s instructions. The lid shall be kept closed at all times except for loading and unloading paint spray equipment or servicing the system. Do not use this equipment if leaks are present. Spent solvents shall be disposed as necessary to ensure proper equipment operation.

7–6.1.3. Non–atomized cleaning. Clean the paint spray gun by placing solvent into the pressure pot or cup and forcing solvent through the spray gun into a suitable waste container. Do not atomize the effluent. The waste container shall be closed when not in use to prevent solvent evaporation.

7–6.1.4. Disassembled gun cleaning. Clean the disassembled paint spray gun by hand or by soaking the parts in a container. Brushes may be used to assist in cleaning detailed parts. The container shall be closed while parts are soaking and when not in use. Do not immerse the entire paint spray gun.



The drawing indicates that tooth marked 3 mils is covered with the wet paint and tooth marked 4 mils is not covered. This indicates that the true wet film thickness of the material is between 3 and 4 mils thick.

Figure 7-7. Wet Film Thickness Gage

7-6.1.5. Removal of dried paint. After several months of use or when clogged with dried paint, the spray gun may be cleaned by completely dismantling and soaking metal components, such as the air nozzle, fluid nozzle, and needle assembly, in MIL-PRF-83936 tank-type paint remover per Chapter 5. Do not immerse the entire paint spray gun or any plastic components into a paint remover tank.

7-7. PREPARATION OF SURFACES FOR PAINTING. Much of the effectiveness of a paint finish depends on careful preparation of the surface prior to applying the coatings. Surface preparation includes scuff sanding of old existing paint, cleaning, and chemical conversion coating of any bare metal.

WARNING

Some coatings contain chromium compounds, lead compounds, and other heavy metal pigments. Wear eye protection and ensure adequate safety precautions are in place to prevent exposure to dust during sanding operations. Contact the local Industrial Hygiene Activity or Occupational Safety and Health Office for guidance on the proper selection of respiratory protection and other personal safety requirements.

CAUTION

When scuff sanding and feathering paint coatings, avoid contact with metal and composite substrates. Abrasion of substrate materials can damage structural integrity.

NOTE

Proper surface preparation cannot be emphasized enough. Almost all failed paint jobs (peeling off) can be traced to poor surface preparation. Carefully follow all corrosion control, deoxidation, chemical conversion and solvent wipe-down procedures before applying any primer or self-priming topcoat to metal surfaces.

7-7.1. Preparation of aged paint. Aged paint coatings (those allowed to cure seven days or more) must be scuff sanded to ensure adhesion of additional paint coatings. Scuff sand using 150 grit or finer aluminum oxide cloth (A-A-1048), abrasive mat (A-A-58054), or oscillating sander (A–A–2687) with aluminum oxide cloth. Scuff sanding requires a complete roughening of the paint surface, however, avoid aggressive scuff sanding which can expose the substrate and promote corrosion of metal and degradation of composite materials. Unevenly matched faying surface joints or fasteners and sharply protruding objects or corners shall be scuff sanded by hand to avoid sanding through the coating. After scuff sanding, remove dry residue using clean cheesecloth (A–A–1491) dampened with water, followed by wiping with clean cheesecloth dampened with thinner (MIL–T–81772, Type I or TT–T–2935).

7–7.2. Final inspection and preparation.

a. Inspect surface to be painted to ensure all corrosion has been properly removed. Surfaces must be cleaned and properly treated using chemical conversion coating (see Chapters 3 and 5).

b. Replace any seam sealants when necessary, as described in Chapter 6.

c. Mask surrounding areas to protect from paint overspray. Paint masking tape (AMS–T–21595, Type I) and brown masking paper (A–A–203) are suitable for most masking requirements. For touch–up spray applications, it is often desirable to mask to a seam or line to prevent the appearance of a paint edge after masking material is removed.

d. If the chemically treated metal has been allowed to accumulate oil, grease, fingerprints, or other contaminants, solvent wipe just prior to painting with clean cheesecloth (A–A–1491) dampened with thinner (MIL–T–81772, Type I). Environmental regulations in most locations prohibit the use of wipe solvents with vapor pressures greater than 45 millimeters of mercury (mm Hg). The vapor pressure of MIL–T–81772, Type I, is approximately 35 mm Hg.

7–8. GENERAL PAINT APPLICATION PROCEDURES. The following procedures are general rules to be followed when applying paint. For more detailed information on the application of paint finishes, refer to MIL–F–18264 (Application and Control of Finishes, Organic, Weapons System).

WARNING

Aircraft shall be electrically grounded during all painting procedures in order to guard against the danger of fire from static electricity.

7–8.1. General spraying techniques. (see Figures 7–8 to 7–16)

a. Prior to spraying, the gun should be checked to ensure that it produces the proper spray pattern. Figure 7–8 shows correct spray patterns and tips on how to achieve them. Figure 7–9 shows incorrect patterns, causes, and suggested remedies.

b. Always have the spray gun in motion before spraying.

c. Keep the spray gun at a consistent distance from the work during application.

d. Move the spray gun across the work at a consistent speed.

e. For large surfaces, trigger the spray gun after beginning and before ending each stroke.

f. Start the first stroke at the same point on each similar object.

g. Always overlap half of the pattern of the previous stroke.

h. On similar pieces of work, always try to use the same number of strokes or passes.

i. End the last stroke in the same place on similar objects.

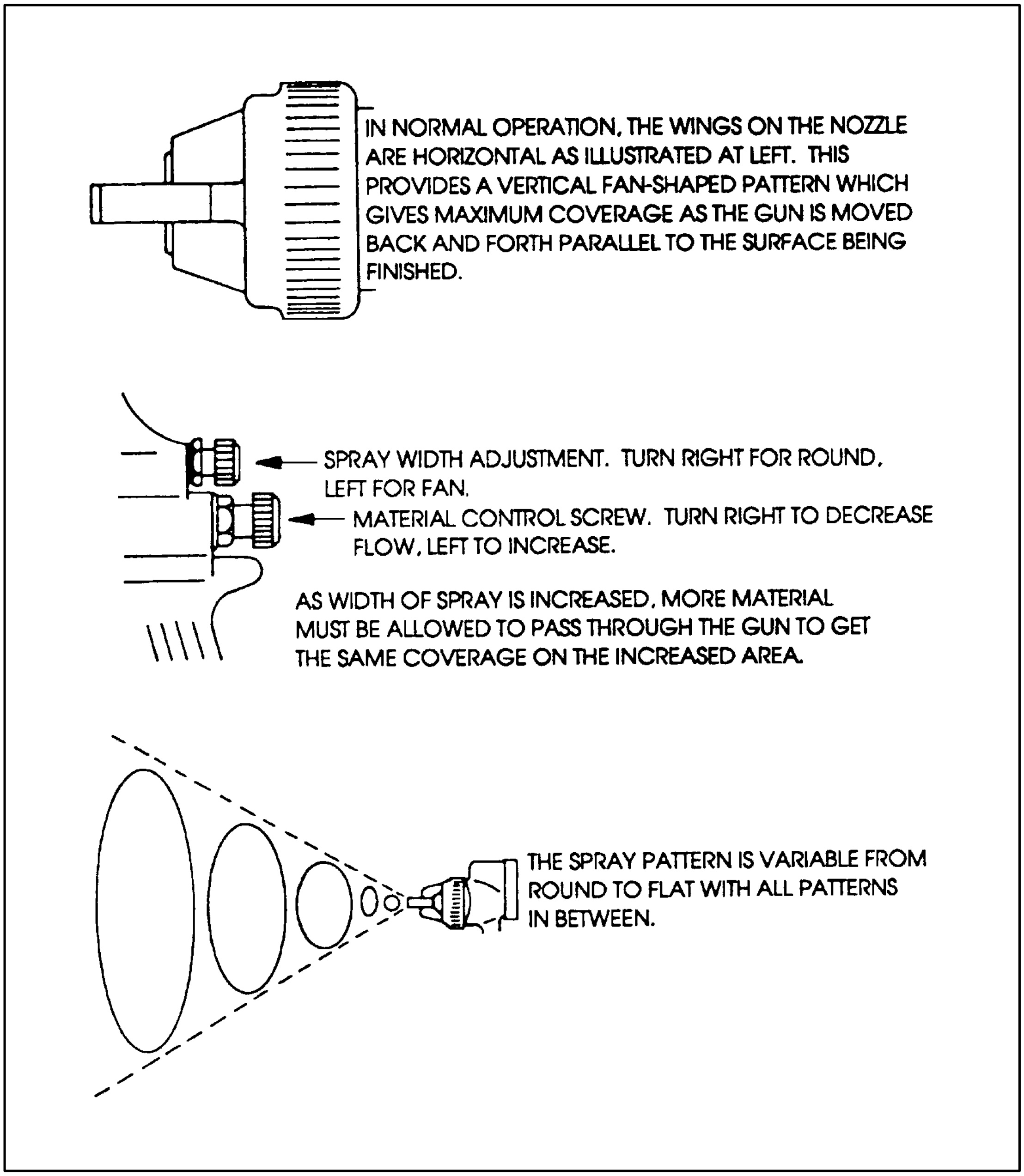


Figure 7-8. Obtaining Correct Spray Pattern

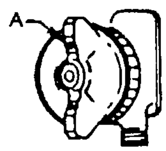
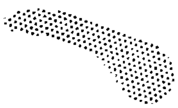
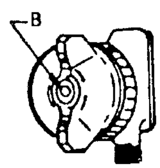
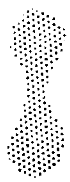
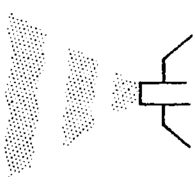
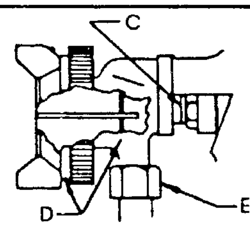
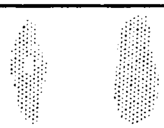
PATTERN	CAUSE	CORRECTION
	DRIED MATERIAL IN SIDE PORT A RESTRICTS PASSAGE OF AIR THROUGH IT. RESULTS: FULL PRESSURE OF AIR FROM CLEAN SIDE PORT FORCES FAN PATTERN IN DIRECTION OF CLOGGED SIDE. 	DISSOLVE MATERIAL IN SIDE PORT WITH THINNER. DO NOT POKE IN ANY OF THE OPENINGS WITH METAL INSTRUMENTS.
	DRIED MATERIAL AROUND THE OUTSIDE OF THE FLUID NOZZLE TIP AT POSITION B RESTRICTS THE PASSAGE OF ATOMIZING AIR AT ONE POINT THROUGH THE CENTER OPENING OF AIR NOZZLE AND RESULTS IN PATTERN SHOWN. THIS PATTERN CAN ALSO BE CAUSED BY LOOSE AIR NOZZLE. 	IF DRIED MATERIAL IS CAUSING THE TROUBLE, REMOVE AIR NOZZLE AND WIPE OFF FLUID TIP, USING RAG WET WITH THINNER. TIGHTEN AIR NOZZLE.
	A SPLIT SPRAY OR ONE THAT IS HEAVY ON EACH END OF A FAN PATTERN AND WEAK IN THE MIDDLE IS USUALLY CAUSED BY (a) TOO HIGH AN ATOMIZING AIR PRESSURE, OR (b) BY ATTEMPTING TO GET TOO WIDE A SPRAY WITH THIN MATERIAL.	REDUCING AIR PRESSURE WILL CORRECT CAUSE (a). TO CORRECT CAUSE (b), OPEN MATERIAL CONTROL (SEE FIGURE 6-3) TO FULL POSITION BY TURNING TO LEFT. AT THE SAME TIME TURN SPRAY WITH ADJUSTMENT (SEE FIGURE 6-3) TO RIGHT. THIS WILL REDUCE WIDTH OF SPRAY BUT WILL CORRECT SPLIT SPRAY PATTERN.
	(a) DRIED OUT PACKING AROUND MATERIAL NEEDLE VALVE PERMITS AIR TO GET INTO FLUID PASSAGEWAY. THIS RESULTS IN SPITTING. (b) DIRT BETWEEN FLUID NOZZLE SEAT AND BODY OR A LOOSELY INSTALLED FLUID NOZZLE WILL MAKE A GUN SPIT. (c) A LOOSE OR DEFECTIVE SWIVEL NUT ON SIPHON CUP OR MATERIAL HOSE CAN CAUSE SPITTING.	 TO CORRECT CAUSE (a), BACK UP KNURLED NUT C, PLACE TWO DROPS OF MACHINE OIL ON PACKING, REPLACE NUT AND TIGHTEN WITH FINGERS ONLY. IN AGGRAVATED CASES, REPLACE PACKING. TO CORRECT CAUSE (b), REMOVE FLUID NOZZLE D, CLEAN BACK OF NOZZLE SEAT IN GUN BODY USING RAG WET WITH THINNER, REPLACE NOZZLE AND DRAW UP TIGHTLY AGAINST BODY. TO CORRECT CAUSE (c) TIGHTEN OR REPLACE SWIVEL NUT E.
	A FAN SPRAY PATTERN THAT IS HEAVY IN THE MIDDLE, OR A PATTERN THAT HAS AN UNATOMIZED "SALT-AND-PEPPER" EFFECT INDICATES THAT THE ATOMIZING AIR PRESSURE IS NOT SUFFICIENTLY HIGH.	INCREASE PRESSURE FROM YOUR AIR SUPPLY. CORRECT AIR PRESSURES ARE DISCUSSED ELSEWHERE IN THIS INSTRUCTION SHEET.

Figure 7-9. Faulty Spray Patterns and Suggested Corrections

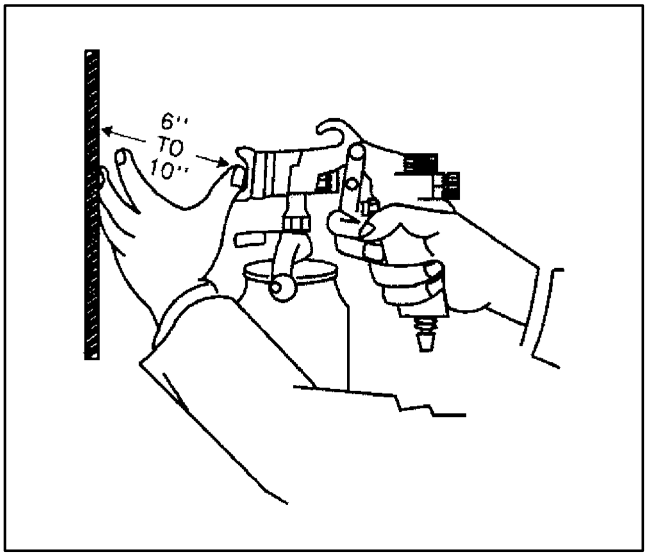


Figure 7–10. Estimating Distance to Work Surface

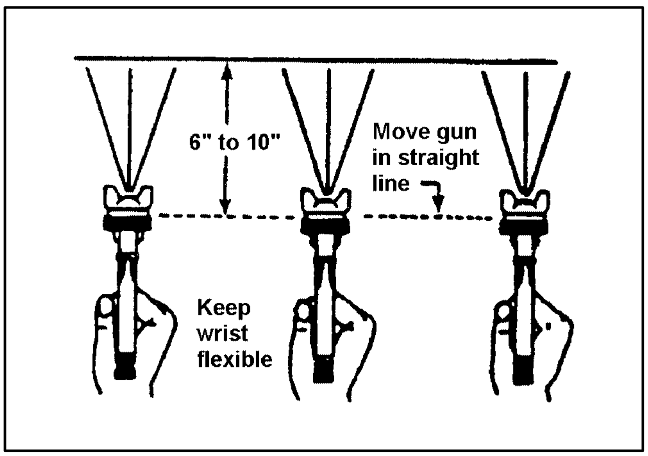


Figure 7–11. Parallel Movement of Spray Gun

7–8.2. Spray gun distance.

a. Keep the spray gun at the same distance from the work during application. The proper distance of the spray gun from the work varies with the spray pattern and type of application. When the spray gun is close to the surface being painted, it must be moved more rapidly to prevent runs and sags. For most processes, spray gun distance from the work should be approximately 6 to 10 inches. See Figures 7–10 and 7–11.

b. A full coat of paint through which most materials cannot be seen is called a full wet coat. For a wet, heavy coat, move the spray gun closer to the surface or move the gun more slowly across the surface to increase the volume of paint being applied.

c. A light coat of paint through which most materials can be seen is called a mist coat. For a light film build or for a mist coat, move the spray gun further away or move the gun more quickly across the surface to decrease the volume of paint being applied.

7–8.3. Spray application.

a. Hold the paint gun so that the spray is always perpendicular to the surface being painted (Figure 7–11).

b. Move the spray gun parallel to the surface to maintain the same distance from the surface. Move both your arm and shoulder, along with the paint gun, to avoid “arcing” and tilting the spray gun (Figures 7–11, 7–12, 7–13, and 7–14). Overlap approximately half of the pattern of the previous stroke.

c. Slow gun travel gives a wet, heavy film build; fast gun travel gives a light film build.

d. Trigger the spray gun after the stroke has been started. Release the trigger before the end of the stroke. This reduces paint loss, prevents heavy build up of paint on the corners and edges of work, and prevents runs and drips at the beginning and end of the stroke. If the trigger is not completely pulled, only air will flow through the gun (Figure 7–15).

e. To achieve the desired film thickness, primers can usually be applied in one spray coat; topcoats usually require two coats with specific dry time between coats to allow proper solvent evaporation, film leveling, and curing properties. The second coat should be applied in a cross coat to ensure adequate coverage (Figure 7–16).

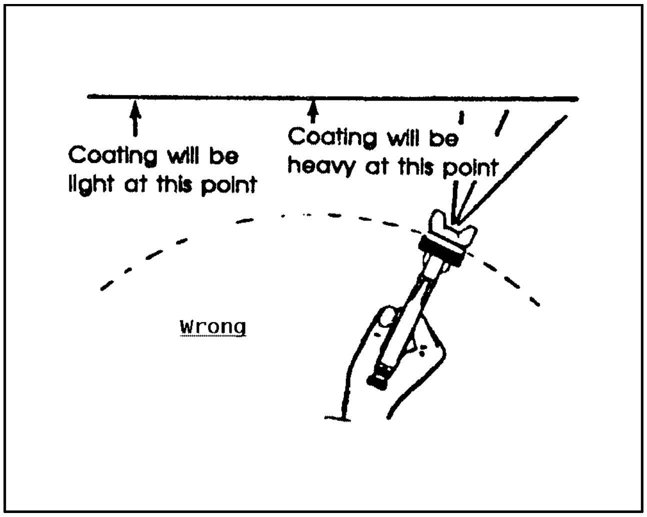


Figure 7-12. Avoid Arcing the Spray Gun

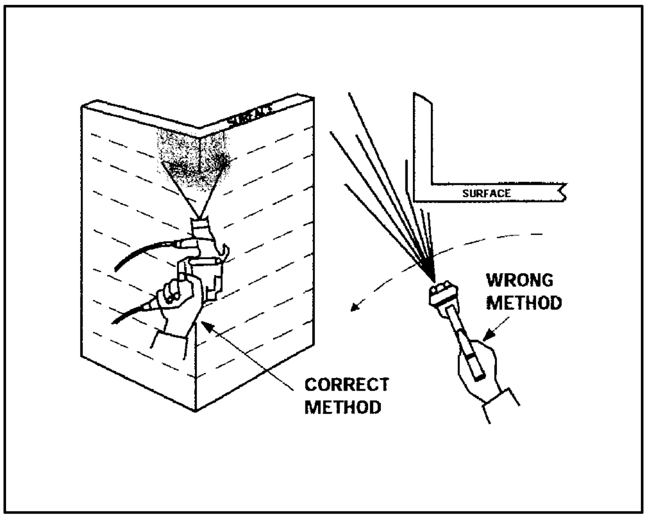


Figure 7-13. Spraying Corners

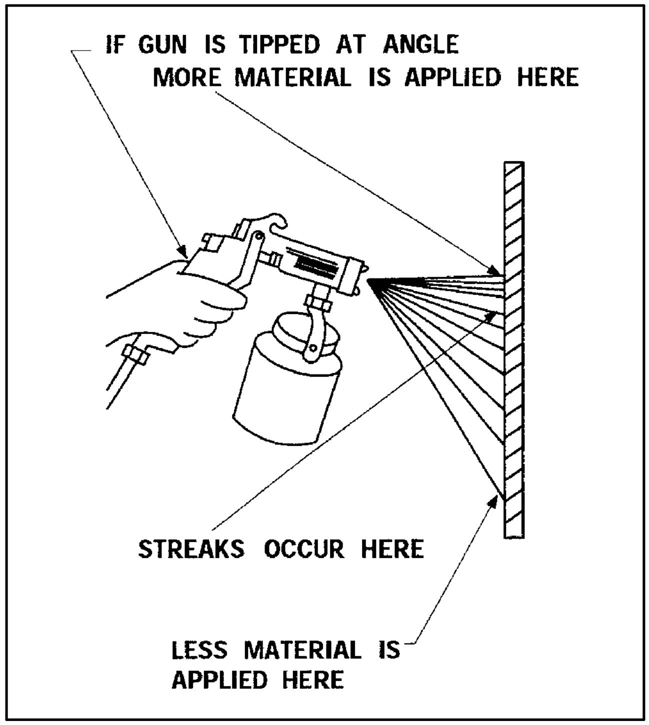


Figure 7-14. Improper Spray Angle

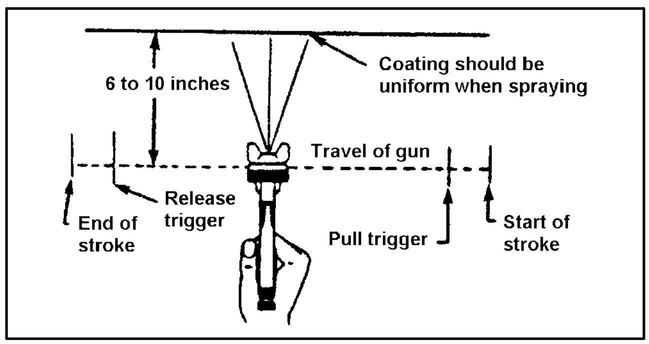


Figure 7-15. Triggering the Spray Gun

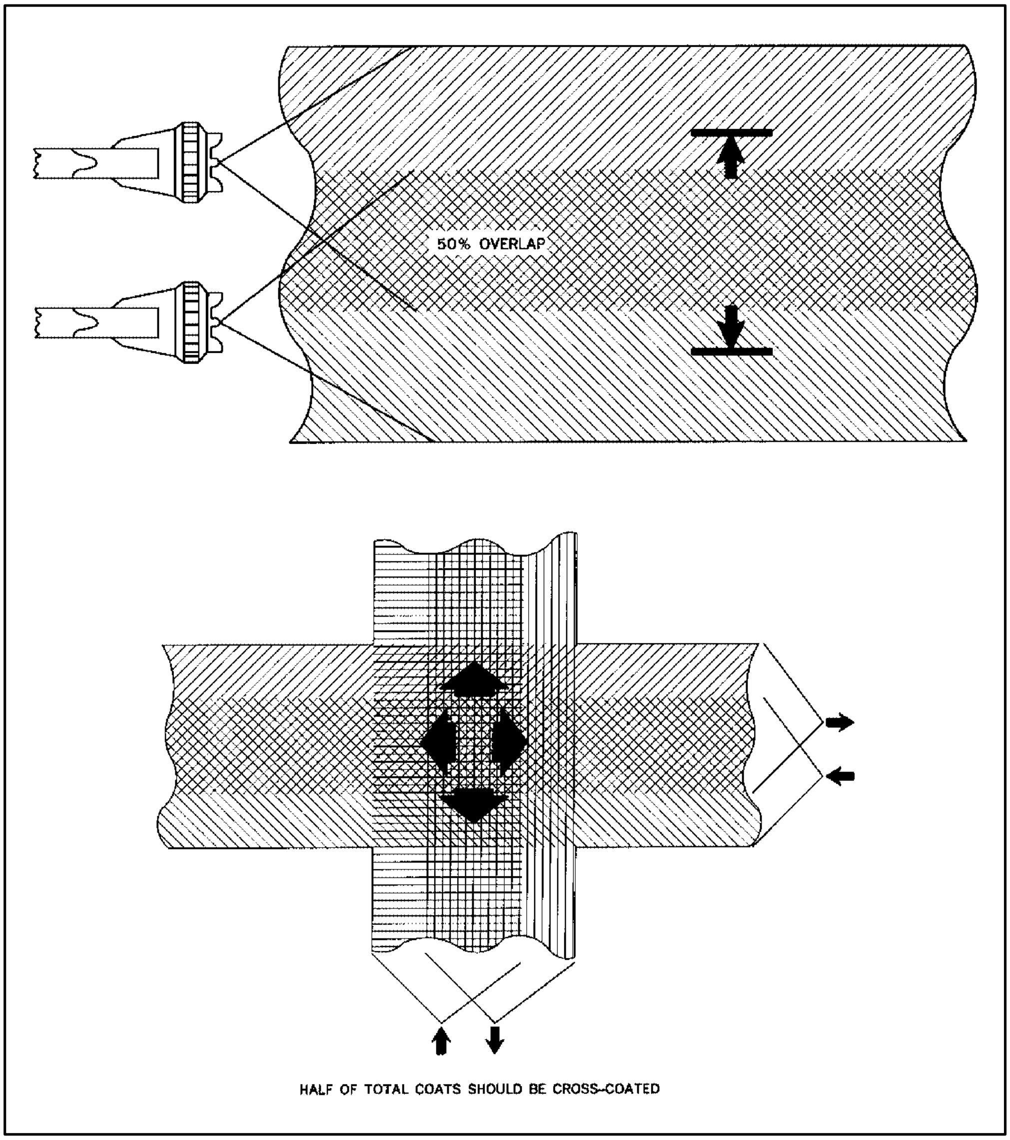


Figure 7-16. Proper Spray Pattern Overlap

Table 7–3. Paint Finish Problems

Appearance	Probable Cause	Prevention
Chalking (Loss of gloss; powdery surface)	Weathering of paint films (particularly epoxy topcoats); insufficient paint agitation during mixing.	Polyurethane topcoats are not as prone to chalking; use epoxy topcoats only when necessary; ensure coating materials are thoroughly mixed prior to application.
Checking, Crazing, Cracking (crowfoot separation, irregular line separation, mud cracking)	Insufficient drying of films prior to recoating; extreme temperature changes during drying; coats applied too heavy; ingredients not thoroughly mixed; incorrect thinner; solvent softening of lacquer undercoats.	Allow sufficient drying time before recoating; avoid extreme temperature changes while applying coating and while coating is drying; avoid heavy coats; mix coatings thoroughly before applying; avoid incompatible additives; do not apply polyurethane or epoxy topcoats over lacquer paint (lacquer is easily softened with MIL–T–81772, Type I thinner).
Blistering (broken edge craters; small, swelled areas similar to blisters on human skin)	Contamination or corrosion under coatings; trapped solvents; exposure of film to constant or repeated high humidity; water in spray gun air line.	Ensure surfaces are clean and free of corrosion prior to applying coatings; avoid applying coatings in extremely hot weather; routinely drain water from spray gun air lines; allow sufficient drying time between coats.
Peeling, Lifting (separation of coating from undercoats or substrate)	Improper surface preparation; improper undercoats; inadequate dry time between coats.	Ensure surfaces are clean prior to coating; use recommended primers; allow sufficient dry time between primer and topcoat. Ensure that the proper chemical conversion coating is present on the substrate.
Fish Eyes, Poor Wetting (separation of the wet film; undercoat can be seen in spots)	Improper cleaning of surface prior to painting; oil or water in spray gun air line.	Clean surface properly; ensure spray gun air supply has oil and water separator.
Dirt or Trash in Finish (foreign particles dried in the paint film)	Lack of proper cleaning, blowing off, tack ragging; dirt in air supply line or spray gun; dirty working area; defective or dirty air inlet filters; coating not properly strained.	Clean surface thoroughly; blow out cracks and seams; clean equipment thoroughly; clean up spray area; replace air inlet filters; strain coatings prior to application; keep containers closed.
Runs, Sags (running of wet paint in rivulets; partial slipping of paint)	Too much thinner; cold surface; gun at improper angle or too close to surface; too much coating applied at one time; improper gun adjustment.	Do not add excessive thinner to coatings (refer to specific instructions later in this chapter); ensure surface is at proper temperature; hold gun at proper angle and distance; avoid heavy coats; refer to gun manufacturer’s instructions for proper adjustment.

Table 7–3. Paint Finish Problems (Cont.)

Appearance	Probable Cause	Prevention
Orange Peel (ball peen hammer dents in coating surface; resembles the skin of an orange)	Inadequate dry time between coats; surface drying too fast; improper gun adjustment.	Allow proper dry time between coats; ensure temperatures of material and surface are within the specified range; refer to gun manufacturer's instructions for proper adjustment.
Pin Holes/Hazing, Particularly in Gloss High–solids Polyurethane Paints (tiny bubbles or holes widespread in the dried coating)	Paint applied too thickly; insufficient dry time between coats; ambient temperature too high.	Avoid heavy coats; avoid applying paint when ambient temperature exceeds 90_F.

7–8.4. Spray painting defects. During spray application of paints, certain defects may appear on the finish due to faulty application methods or poor application conditions. The most common defects, probable causes, and remedies are listed in Table 7–3. For spray touch–up processes, an exact color or gloss match is extremely difficult to obtain and shall not be used as criteria for quality control. Slight orange peel that does not affect operational conditions or aerodynamic smoothness per MIL–F–18264 is also acceptable. If unacceptable defects in the paint film are found, repair the defects as follows:

a. For dried defective paint, scuff sand per paragraph 7–7 and refinish in accordance with instructions provided in this chapter for the specific coating being used.

b. For wet, freshly painted surfaces, remove defective paint by wiping with a cloth dampened with an approved solvent. In general, residue from polyurethane coatings such as MIL–PRF–85285, TT–P–2756, and TT–P–2760 can be removed using MIL–T–81772, Type I Thinner. Residue from epoxy coatings such as MIL–C–22750 and MIL–P–23377 can be removed using MIL–T–81772, Type II Thinner. Residue from waterborne coatings such as MIL–PRF–85582 can be removed using a combination of water and TT–I–735 (Isopropyl Alcohol). Consult the local Environmental Affairs Office for guidance on pertinent regulatory requirements.

7–8.5. Brush and roller application. Brush or roller application of paint is preferred when painting small areas or when spray painting is not convenient or permitted. The advantage of brush and roller application is that the paint does not become atomized and airborne, thus minimizing safety and health concerns. However, when applying paint by roller, several coats may be necessary to achieve adequate film thickness.

7–8.5.1. Brush. Brush application shall be limited to small nicks, chips, or scratches. When brushing, the coating should be applied in one direction, then cross brushed to completely cover the area. Near the end of each stroke, the brush should be gradually lifted to prevent excessive roughness from brush marks. The coating material should be stirred frequently during use to avoid settling. A brush applied coat should be allowed to dry completely before applying subsequent coats.

7–8.5.2. Roller. In roller application, the coating material should be placed in a paint tray having a sloping bottom. The tray must be sized to accommodate the roller and coating material. The roller is dipped into the tray and rolled back and forth until it is coated. Excess material on the roller is removed by rolling out on the tray grid. The coating is applied by slowly rolling it back and forth across the surface until uniform coverage is obtained. Once a uniform coating is achieved, allow it to dry completely before applying additional coats. During roller application, adjacent strips should be overlapped as in other methods of painting. Since the roller will not fit into corners or other tight areas, these surfaces may be coated using a brush before beginning the roller application. The roller should follow the brushing promptly to avoid lap marks.

7–8.6. Paint or primer adhesion testing. This test is required after all topcoating and/or priming operations. If the primer coat is the only coat applied, then this test applies. If the primer coat is to be topcoated, then this test applies to the topcoat only. This test is applicable to primed/painted areas greater than 2 square feet in total area.

7–8.6.1. Wet tape adhesion test. Allow the primer/paint to dry at least 48 hours before performing the tape test. Use a 4” X 4” square cut cheesecloth (A–A–1491) layers to equal a pad 1/8” thick. Saturate the pad in water and place it against the surface to be tested. Overlay a larger sheet of polyethylene (MIL–PRF–5425) over the wet pad and tape the edges down, use 3M No. 231 (AMS–T–21595, Type I) masking tape or equal. Mark the polyethylene sheet with the date and time. Allow 24 hours dwell time and then remove the cloth and wipe the area dry with a clean, dry cheesecloth. Before one minute passes, apply a one inch wide by six inches long piece of 3M No. 250 (A–A–883, Type II) flatback masking tape (adhesive side down) across the test area. Ensure that 4 inches of the tape covers the test area and two inches are left unattached for gripping purposes. Press the tape down in the test area with a firm hand pressure (use of tape and decal applicator, P/N: 3M PA–1, is also authorized). Grip the 2 inch loose end of the tape and remove the tape in one abrubt motion.

7–8.6.2. Pass/fail criteria. If no paint/primer was removed, the adhesion test passed. If more than one square inch (total) of paint/primer was removed, the test failed and the entire surface must be stripped and re–coated in accordance with this manual. If paint/primer was removed but the total area removed was less than one square inch, then a retest must be performed per the following paragraph.

NOTE

It may be more economical to strip and recoat rather than retest.

7–8.6.3. Retest of failed area less than one square inch. Perform three additional wet tape tests in adjacent areas to the failed area. All three tests must pass (no coating removed). The coating is considered to have failed adhesion requirements if any coating was removed in the three retests. If this is the case, the surface must be stripped and re–coated in accordance with this manual. If no coating is removed in the retest, touch up the removed coating from the first test and continue processing.

7–8.6.4. Adhesion testing for touchup areas. In order to test for proper adhesion of small areas of touchup coating (less than two square feet, total), a dry tape test is authorized. Allow the coating (primer/paint) to dry for 48 hours before testing. Apply the 1 inch wide by 6 inches long piece of 3M No. 250 (A–A–883, Type II) flatback masking tape across the touchup area and proceed with the test as described in the last three sentences in the wet tape adhesion test paragraph. Any coating removal defines a test failure. Strip and re–coat the touchup area per this manual.

7–9. SPECIFIC COATING REQUIREMENTS. The following are instructions and guidelines for specific materials, primers, topcoats, and commonly used specialty coatings. Refer to Table 7–2 to determine which coatings are used during touch–up operations.

7–9.1. Aircraft Paint Thinner (MIL–T–81772). This specification covers three types of paint thinners compatible with various coating materials. Due to chemical incompatibility, no single paint thinner is acceptable for all types of coatings. Environmental regulations restrict the amount of thinner that can be added to aircraft coatings. Fortunately, newer coatings and application technologies do not usually require additional thinner. As stated in paragraph 7–4.1.1, aircraft coatings must meet strict VOC requirements. Do not add thinner to coatings unless specifically indicated on the container label or on manufacturer’s literature supplied with the material. MIL–T–81772 Thinner is available in the following types:

a. Type I – Polyurethane coating thinner;

b. Type II – Epoxy coating thinner; and

c. Type III – Lacquer coating thinner.

7–9.2. High–Solids Epoxy Primer (MIL–P–23377).

WARNING

Aircraft coating materials and thinners are highly flammable. Never store, open, or apply these materials near ignition sources such as lighted cigarettes, sparks, electrical arcing, heat sources, etc. No eating, drinking, or smoking is allowed in areas where coatings or solvents are used or stored.

Personnel mixing and applying coating materials or performing equipment cleanup operations shall wear chemical or splash proof goggles, solvent resistant gloves (MIL–G–12223 or others meeting OSHA requirements), approved coveralls (A–A–55196 or MIL–C–2202), and a respirator. Consult the local Industrial Hygiene Activity for proper respirator selection and use. Avoid breathing fumes. Do not allow coating materials to contact skin or eyes.

Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. Prolonged or repeated skin contact with organic solvents can have local (skin) and systemic (internal organ) toxic effects.

Aircraft primers contain toxic chromate based corrosion inhibiting pigments. Airborne primer mists are toxic.

Consult the applicable material safety data sheet (MSDS) for additional safety information.

CAUTION

Only mix materials from the same manufacturer. Do not mix components from different manufacturers. Specified mixing ratios must be followed closely to avoid unsatisfactory film properties such as inadequate drying, poor adhesion, and poor solvent resistance.

7–9.2.1. Description. MIL–P–23377 is a VOC compliant (340 G/L maximum) high–solids epoxy primer with corrosion inhibitors. This specification covers two types and two classes of materials. Type I is the standard yellow primer used primarily in high gloss paint systems and on interior components and surfaces. Type II is the dark green low infrared reflective primer used in tactical paint schemes on exterior surfaces. Each type contains two classes: Class C (strontium chromate based corrosion inhibitor) and Class N (non–chromate based corrosion inhibitor). Consult specific maintenance instructions for guidance on the selection primers for each weapons system. Class C of MIL–P–23377 primer shall be selected when no class is specified. Class N shall not be substituted for Class C unless authorization for its use is given by the engineering authority for the system or item to which the primer coating is to be applied. These primers can be applied to properly treated metal surfaces and to cured, scuff sanded primers and topcoats. They dry to durable, chemical resistant films and offer excellent protection against corrosion, particularly when coupled with a compatible topcoat.

7–9.2.2. Temperature requirements. Ensure the temperature for each component is between 60_F and 90_F before mixing and application. Surface temperature of the area to be coated must be between 50_F and 95_F. Do not apply this material if the ambient temperature is below 50_F.

7–9.2.3. Material preparation. MIL–P–23377 primer is supplied as a two component kit. The two components must be mixed together in the proper proportions prior to use. One component contains the pigment within an epoxy vehicle, while the other component contains the resin solution. These components are packaged separately and have excellent storage stability. Once mixed, however, the two components undergo a chemical reaction to achieve proper film characteristics. Over a few hours, the coating will gel and harden regardless of whether or not it is exposed to air. Pot life is a measure of the length of time a catalyzed coating remains useful for application. In general, the pot life of epoxy primer is 4 hours. During hot or humid conditions, the pot life will decrease. Only mix enough material that can be used within two hours. Do not add thinner to attempt to compensate for coatings beyond useful pot life. Mix the primer as follows:

a. Mix the pigmented component thoroughly to ensure that the solids are completely dispersed. Use a paint shaker for approximately 10 minutes if possible. If a paint shaker is not available, use a clean metal or wooden paddle to stir the contents. After mixing, check the bottom of the container to ensure that all of the pigment is dispersed.

b. Pour the pigmented component into a clean, empty container. The empty container must be at least two times the capacity of the pigmented component.

CAUTION

Only mix materials from the same manufacturer. Never mix materials from different manufacturers. Mix the two components in the volume ratio specified by the manufacturer. Refer to the container label.

c. Pour the required amount of resin component slowly into the container with the pigmented component. Stir thoroughly with a metal or wooden paddle. To remain compliant with environmental regulations, do not add thinner to this material unless specifically required per manufacturer's instructions.

7–9.2.4. Spray application. After the primer is thoroughly stirred, strain the material through a disposable paint strainer to remove coarse particles. Prior to spraying, allow the mixed primer to stand for approximately 30 minutes. This induction period is necessary to allow components to partially react. Spray the mixed primer in accordance with paragraph 7–8.

7–9.2.5. Brush or roller application. For brush or roller application, strain the primer and allow it to stand for 30 minutes as per paragraph 7–9.2.4. Apply the primer uniformly to the surface in one coat (refer to paragraph 7–8.7).

7–9.2.6. Touch–up pen application. For convenient touch–up of small areas, MIL–P–23377 Epoxy Primer is available in touch–up pens. Refer to paragraph 7–5.7.

7–9.2.7. Film thickness. The total dry film thickness of primer shall be 0.6 to 0.9 mils (0.0006 to 0.0009 inch) which is slightly more than a mist coat. After the coating has dried, the substrate should be barely visible through the film. Dry film thickness can be estimated using a wet film thickness gage. Dry film thickness will be approximately 50 percent of the wet film thickness. Refer to paragraph 7–5.9. Primer thickness shall be doubled if no topcoat is to be applied.

7–9.2.8. Drying time. Tack–free drying time of MIL–P–23377 primer depends upon the temperature, but is generally between 30 minutes and 2 hours. Tack–free means that the coating can be touched lightly with the fingertip without noticeable tackiness. Do not apply topcoat unless the primer is tack–free. At this stage of drying, the primer is not completely cured and can be easily marred. MIL–P–23377 primer will dry hard in approximately 8 hours at 70_F, which means the coating is fairly durable and can be handled. The primer dries slowly at lower temperatures. Topcoat is generally applied within 24 hours after primer application. If the primer has dried for over 24 hours but not longer than 7 days, proceed as follows:

a. Clean the surface by wiping with clean cheesecloth dampened with MIL–T–81772, Type I Thinner.

b. Apply a thin (mist) coat of epoxy primer (MIL–P–23377).

c. Allow primer to dry tack–free and then apply the specified topcoat.

NOTE

To ensure proper adhesion, if the primer has dried longer than 7 days, it must be lightly scuff sanded prior to proceeding with steps a, b, and c above.

7–9.3. Waterborne Epoxy Primer (MIL–PRF–85582).

WARNING

Aircraft coating materials and thinners are highly flammable. Never store, open, or apply these materials near ignition sources such as lighted cigarettes, sparks, electrical arcing, heat sources, etc. No eating, drinking, or smoking is allowed in areas where coatings or solvents are used or stored.

Personnel mixing and applying coating materials or performing equipment cleanup operations shall wear chemical or splash proof goggles, solvent resistant gloves (MIL–G–12223 or others meeting OSHA requirements), approved coveralls (A–A–55196 or MIL–C–2202), and a respirator. Consult the local Industrial Hygiene Activity for proper respirator selection and use. Avoid breathing fumes. Do not allow coating materials to contact skin or eyes.

Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. Prolonged or repeated skin contact with organic solvents can have local (skin) and systemic (internal organ) toxic effects.

Aircraft primers contain toxic chromate based corrosion inhibiting pigments. Airborne primer mists are toxic.

Consult the applicable material safety data sheet (MSDS) for additional safety information.

CAUTION

Only mix materials from the same manufacturer. Do not mix components from different manufacturers. Specified mixing ratios must be followed closely to avoid unsatisfactory film properties such as inadequate drying, poor adhesion, and poor solvent resistance.

7–9.3.1. Description. MIL–PRF–85582 (formerly MIL–P–85582) is a VOC compliant (340 G/L maximum) waterborne epoxy primer with corrosion inhibitors. This specification covers two types and three classes of materials. Type I is the standard yellow primer used primarily in high gloss paint systems and on interior components and surfaces. Type II is the low infrared reflective primer used in tactical paint schemes. Type II primer is dark green. Each type contains three classes: Class C1 (barium chromate based corrosion inhibitor), Class C2 (strontium chromate based corrosion inhibitor), and Class N (non–chromate based corrosion inhibitor). Consult specific maintenance instructions for guidance on the selection primers for each weapons system. Class C1 is the most commonly used MIL–PRF–85582 primer and shall be selected when no class is specified. Class N shall not be substituted for Class C1 or C2 unless authorization for its use is given by the engineering authority for the system or item to which the primer coating is to be applied. These primers can be applied to properly treated metal surfaces and to cured, scuff sanded primers and topcoats. They dry to durable, chemical resistant films and offer excellent protection against corrosion, particularly when coupled with a compatible topcoat.

7–9.3.2. Material compatibility. MIL–PRF–85582 waterborne epoxy primer is generally interchangeable with MIL–P–23377 high–solids epoxy primer except for specific applications. Since MIL–PRF–85582 primer contains water, to prevent possible corrosion it shall not be used for wet installations (refer to paragraph 7–4.8) and for direct application to bare steel.

7–9.3.3. Temperature requirements. Ensure the temperature for each MIL–PRF–85582 primer component is between 60_F and 90_F before mixing and application. Surface temperature of the area to be coated must be between 55_F and 95_F. Do not apply this material if the ambient temperature is below 55_F.

7–9.3.4. Material preparation. MIL–PRF–85582 primer is supplied as a two component kit. The two components must be mixed together in the proper proportions prior to use. Distilled or deionized water is also required in most cases as an additional component. One component contains the pigment within an epoxy vehicle, while the other component contains the clear resin solution. These components are packaged separately and have excellent storage stability. Once mixed, however, the two components undergo a chemical reaction to achieve proper film characteristics. Over a few hours, the coating will gel regardless of whether or not it is exposed to air. Pot life is a measure of the length of time a catalyzed coating remains useful for application. In general, the pot life of waterborne epoxy primer is 4 hours. During hot or humid conditions, the pot life will decrease. Only mix enough material that can be used within two hours. Do not add thinner or water to attempt to compensate for coatings beyond useful pot life. Mix the primer as follows:

a. Consult manufacturer’s instructions printed on the container label for proper mixing procedures. If distilled or deionized water is specified, do not add tap water. Tap water will have an adverse affect on film properties. Only add the specified amount of water. Do not add excessive water.

CAUTION

Only mix materials from the same manufacturer. Never mix materials from different manufacturers. Mix the two components in the volume ratio specified by the manufacturer. Refer to the container label.

b. Following manufacturer's instructions, mix the components as necessary to ensure that solids are completely dispersed. If using a paint shaker, do not exceed manufacturer's specified agitation time since excessive shaking can cause the coating to gel prematurely. If no shake time is specified, agitate the material for 10 minutes maximum. If a paint shaker is not available, use a clean metal or wooden paddle to stir the contents. After mixing, check the bottom of the container to ensure that all solids are dispersed.

7–9.3.5. Spray application. After the primer is mixed per manufacturer's instructions, strain the material through a disposable paint strainer to remove course particles. No induction time is necessary prior to spraying this primer. Spray the mixed primer in accordance with paragraph 7–8.

7–9.3.6. Brush or roller application. For brush or roller application, strain the primer and apply it uniformly to the surface in one coat (refer to paragraph 7–8.5).

7–9.3.7. Touch–up pen application. For convenient touch–up of small areas, MIL–PRF–85582 Waterborne Epoxy Primer is available in touch–up pens. Refer to paragraph 7–5.7.

7–9.3.8. Film thickness. The total dry film thickness of the sprayed primer shall be 0.6 to 0.9 mils (0.0006 to 0.0009 inch) which is slightly more than a mist coat. After the coating has dried, the substrate should be barely visible through the film. Dry film thickness can be estimated using a wet film thickness gage. Dry film thickness will be approximately 50 percent of the wet film thickness. Refer to paragraph 7–5.9. Primer thickness shall be doubled if no topcoat is to be applied.

7–9.3.9. Drying time. Tack–free drying time of MIL–PRF–85582 primer depends upon temperature and humidity, but is generally 1 to 2 hours. At 70_F and 50% relative humidity, the primer will be tack–free in 1 hour. Tack–free means that the coating can be touched lightly with the fingertip without noticeable tackiness. Do not apply topcoat unless the primer is tack–free. At this stage of drying, the primer is not completely cured and can be easily marred. MIL–PRF–85582 primer will dry hard in approximately 6 hours at 70_F, which means the coating is fairly durable and can be handled. The primer dries slowly at lower temperatures and higher humidity. Topcoat is generally applied within 24 hours after primer application. If the primer had dried for over 24 hours but not longer than 7 days, proceed as follows:

a. Clean the surface by wiping with clean cheesecloth dampened with MIL–T–81772, Type I Thinner.

b. Apply a thin (mist) coat of epoxy primer (MIL–PRF–85582).

c. Allow primer to dry tack–free and then apply the specified topcoat.

NOTE

To ensure proper adhesion, if the primer has dried longer than 7 days, it must be lightly scuff sanded prior to proceeding with steps a, b, and c above.

7–9.4. Elastomeric Polyurethane Primer (TT–P–2760).

WARNING

Aircraft coating materials and thinners are highly flammable. Never store, open, or apply these materials near ignition sources such as lighted cigarettes, sparks, electrical arcing, heat sources, etc. No eating, drinking, or smoking is allowed in areas where coatings or solvents are used or stored.

Personnel mixing and applying coating materials or performing equipment cleanup operations shall wear chemical or splash proof goggles, solvent resistant gloves

(MIL–G–12223 or others meeting OSHA requirements), approved coveralls (A–A–55196 or MIL–C–2202), and a respirator. Consult the local Industrial Hygiene Activity for proper respirator selection and use. Avoid breathing fumes. Do not allow coating materials to contact skin or eyes.

Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. Prolonged or repeated skin contact with organic solvents can have local (skin) and systemic (internal organ) toxic effects.

Aircraft primers contain toxic strontium, barium, or zinc chromate corrosion inhibiting pigments. Airborne mists are toxic.

Consult the applicable material safety data sheet (MSDS) for additional safety information.

CAUTION

Only mix materials from the same manufacturer. Do not mix components from different manufacturers. Specified mixing ratios must be followed closely to avoid unsatisfactory film properties such as inadequate drying, poor adhesion, and poor solvent resistance.

7–9.4.1. Description. TT–P–2760 is a VOC compliant (340 G/L maximum) flexible polyurethane primer with corrosion inhibitors. This material is designed for use wherever high flexibility is required. This specification covers two types and two classes of materials. Type I is the standard primer used primarily with high gloss paint systems. Type II is the low infrared reflective primer used with tactical paint schemes. Type I primer shall be the natural color of the corrosion inhibiting pigments used. Type II primer is dark green. Each type contains two classes: Class C (strontium chromate based corrosion inhibitor), and Class N (non–chromate based corrosion inhibitor). Consult specific maintenance instructions for guidance on the selection of primers for each weapons system. Class C is the most commonly used TT–P–2760 primer and shall be selected when no class is specified. Class N shall not be substituted for Class C unless authorization for its use is given by the engineering authority for the system or item to which the primer coating is to be applied. These primers can be applied to properly treated metal surfaces and to cured, scuff sanded primers and topcoats. They dry to flexible, chemical resistant films and are usually coupled with MIL–PRF–85285 High–solids Polyurethane Topcoat.

7–9.4.2. Temperature requirements. Ensure the temperature for each component is between 60_F and 90_F before mixing and application. Surface temperature of the area to be coated must be between 60_F and 90_F. Do not apply this material if the ambient temperature is below 60_F.

7–9.4.3. Material preparation. TT–P–2760 primer is supplied as a two component kit. The two components must be mixed together in the proper proportions prior to use. One component contains the pigment within a vehicle, while the other component contains the clear solution. These components are packaged separately and have excellent storage stability. Once mixed, however, the two components undergo a chemical reaction to achieve proper film characteristics. Over a few hours, the coating will gel regardless of whether or not it is exposed to air. Pot life is a measure of the length of time a catalyzed coating remains useful for application. In general, the pot life of this primer is 4 hours. During hot or humid conditions, the pot life will decrease. Only mix enough material that can be used within two hours. Do not add thinner to attempt to compensate for coatings beyond useful pot life. Mix the primer as follows:

a. Consult manufacturer's instructions printed on the container label for proper mixing procedures.

b. Following manufacturer's instructions, mix the components as necessary to ensure that solids are completely dispersed. If using a paint shaker, agitate the material for approximately 10 minutes. If a paint shaker is not available, use a clean metal or wooden paddle to stir the contents. After mixing, check the bottom of the container to ensure that all solids are dispersed.

CAUTION

Only mix materials from the same manufacturer. Never mix materials from different manufacturers. Mix the two components in the volume ratio specified by the manufacturer. Refer to the container label.

c. Pour the required amount of clear resin component slowly into the container with the pigmented component. Stir thoroughly with a metal or wooden paddle. To remain compliant with environmental regulations, do not add thinner to this material unless specifically required per manufacturer's instructions.

7–9.4.4. Spray application. After the primer is mixed per manufacturer's instructions, strain the material through a disposable paint strainer to remove coarse particles. No induction time is necessary prior to spraying this primer. Spray the mixed primer in one wet cross coat in accordance with paragraph 7–8.

7–9.4.5. Brush or roller application. For brush or roller application, strain the primer and apply it uniformly to the surface in one coat (refer to paragraph 7–8.5).

7–9.4.6. Film thickness. The total dry film thickness of primer shall be 1.5 to 2.0 mils (0.0015 to 0.0020 inch). After the coating has dried, the substrate will not be visible through the film. Dry film thickness can be estimated using a wet film thickness gage. Dry film thickness will be approximately 50 percent of the wet film thickness. Refer to paragraph 7–5.9.

7–9.4.7. Drying time. Tack–free drying time of TT–P–2760 primer depends upon temperature and humidity, but will generally be within 5 hours. Tack–free means that the coating can be touched lightly with the fingertip without noticeable tackiness. Do not apply topcoat unless the primer is tack–free. TT–P–2760 primer will be dry hard in approximately 8 hours at 70_F, which means the coating is fairly durable and can be handled. The primer dries slowly at lower temperatures. Topcoat is generally applied between primer tack–free time and 24 hours after primer application. If the primer had dried for over 24 hours but not longer than 7 days, proceed as follows:

a. Clean the surface by wiping with clean cheesecloth dampened with MIL–T–81772, Type I Thinner.

b. Apply a thin (mist) coat of primer (TT–P–2760).

c. Allow primer to dry tack–free and then apply the specified topcoat.

NOTE

To ensure proper adhesion, if the primer has dried longer than 7 days, it must be lightly scuff sanded prior to proceeding with steps a, b, and c above.

7–9.5. Aliphatic Polyurethane Topcoats (MIL–PRF–85285 and TT–P–2756).

WARNING

Aircraft coating materials and thinners are highly flammable. Never store, open, or apply these materials near ignition sources such as lighted cigarettes, sparks, electrical arcing, heat sources, etc. No eating, drinking, or smoking is allowed in areas where coatings or solvents are used or stored.

Personnel mixing and applying coating materials or performing equipment cleanup operations shall wear chemical or splash proof goggles, solvent resistant gloves (MIL–G–12223 or others meeting OSHA requirements), approved coveralls (A–A–55196 or MIL–C–2202), and a respirator. Consult the local Industrial Hygiene Activity for proper respirator selection and use. Avoid breathing fumes. Do not allow coating materials to contact skin or eyes.

Do not open containers that have any evidence of bulging or swelling. Bulged cans are caused by pressure build–up resulting from heat or deterioration of materials. Any attempt to open bulged or swollen cans may result in violent spattering of the contents. Carefully remove bulged or swollen cans to a secure area for proper disposal.

Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. Prolonged or repeated skin contact with organic solvents can have local (skin) and systemic (internal organ) toxic effects.

Consult the applicable material safety data sheet (MSDS) for additional safety information.

CAUTION

Only mix materials from the same manufacturer. Do not mix components from different manufacturers. Specified mixing ratios must be followed closely to avoid unsatisfactory film properties such as inadequate drying, poor adhesion, and poor solvent resistance.

7–9.5.1. Description.

a. MIL–PRF–85285, Type I, High–solids Polyurethane Coating (formerly MIL–C–85285, Type I) is a VOC compliant (420 G/L maximum) topcoat. This specification covers two types of materials. Type I is intended for aircraft use; Type II is intended for use on ground support equipment (GSE). Do not use Type II materials on aircraft surfaces. Type I material is available in gloss, semi–gloss, and flat (lusterless) colors. It is intended for use over properly applied primers conforming to MIL–P–23377, MIL–PRF–85582, or TT–P–2760. The resulting paint system is durable, flexible, weather resistant, corrosion resistant, and chemical resistant.

b. TT–P–2756 Self–Priming Topcoat (SPT) is a VOC compliant (420 G/L maximum) polyurethane coating. SPT may be used only when approved by Type, Model, Series (TMS) engineering authority for the surface or component requiring painting. This material is intended for application directly to properly prepared surfaces without the need for primer. This material has similar film properties as the primer/polyurethane topcoat paint system listed above. It also has excellent adhesion properties and contains corrosion inhibitors to prevent corrosion of aluminum substrates. This material is available in gloss, semi–gloss, and flat (lusterless) colors. TT–P–2756 topcoat is intended for application directly to conversion coated/”alodine” aluminum. However, it can also be applied to clean composite surfaces and as an overcoat on epoxy primer coatings or polyurethane coatings. This material is not approved for use directly on high–strength steel components (i.e., landing gear) and magnesium surfaces without appropriate epoxy primer.

7–9.5.2. Safety requirements for polyurethane coatings. Polyurethane coatings used on Navy and Marine Corps aircraft, such as MIL–PRF–85285 and TT–P–2756, require special handling during mixing, application, and curing to avoid exposure to isocyanate vapors. Adequate ventilation and approved respiratory protection are mandatory. Polyurethane coatings generally present no special health hazards when cured (dried), however, isocyanates are an integral part of the polyurethane reaction and can be released while the coating is still wet. Isocyanate vapors, even in very small concentrations, can produce significant irritation of the skin, eyes, and respiratory tract and may also induce allergic sensitization of personnel. Specific details are provided in OPNAVINST 5100.23.

7–9.5.2.1. Sensitization. Isocyanate sensitization is characterized by bronchial constriction, causing difficulty in breathing, dry cough, and shortness of breath. Individual susceptibility appears to be a controlling factor. Once sensitized, many personnel cannot tolerate even minimal subsequent exposure to isocyanates, and must thereafter avoid work areas where such exposure could occur. In addition, solvents employed with polyurethane coatings tend to increase the rate of absorption and severity of the physiological effect.

7–9.5.2.2. Medical examinations. All personnel assigned duties involving the mixing and application of polyurethane coatings shall receive a baseline medical examination following the guidance of the current edition of the NAVENVIRHLTHCEN Medical Surveillance Procedures Manual to include the protocols for mixed solvents and isocyanates. Periodic medical examinations are required if the results of the industrial hygiene survey recommend them.

7–9.5.2.3. Protective clothing.

WARNING

Protective clothing listed shall not be substituted without specific approval by the local industrial hygienist. Preferred coveralls are disposable (A–A–55196); alternates are green cloth (MIL–C–2202).

a. Personnel applying polyurethane coating shall wear gloves (MIL–G–12223 or meeting OSHA requirements), chemical or splash–proof goggles, coveralls (A–A–55196 or MIL–C–2202) and respiratory protection as specified by the local Industrial Hygiene activity. When polyurethane coating is applied in confined spaces (i.e., intake ducts), contact the local Industrial Hygiene activity for guidance on proper respiratory protection. Consult OPNAVINST 5100.23 for further information.

NOTE

Personnel wearing respirators are required to receive initial and annual fit testing.

7–9.5.2.4. Unprotected personnel. The hangar area shall be cordoned off during paint application to prevent exposure by unprotected personnel. Safe distances for unprotected personnel must be maintained at all times as determined by the local Industrial Hygiene activity.

7–9.5.2.5. Facility requirements. Polyurethane painting operations shall be conducted in an area which has received a workplace evaluation by the local Industrial Hygiene activity. This area shall be sufficiently isolated to prevent exposure to unprotected personnel, as described above. Intermediate maintenance activity production–type spray painting operations or squadron paint touch–up operations employing paint spray equipment shall be conducted only in well ventilated areas approved by the local Industrial Hygiene activity and in accordance with pertinent environmental regulations. Routine Industrial Hygiene evaluations must be obtained by contacting the Occupational Health Office or Medical Clinic. Each facility will maintain a hard copy of the initial and periodic industrial hygiene evaluation. Refer to OPNAVINST 5100.23E for frequency of Industrial Hygiene Evaluations/Surveys.

7–9.5.3. Temperature and humidity requirements. Extreme temperature and humidity conditions will adversely affect film forming properties of polyurethane topcoats. Ensure the temperature for each component is between 60_F and 90_F before mixing and application. Surface temperature of the area to be coated must be between 60_F and 90_F. For best results, apply this material only when the ambient temperature is between 60_F and 90_F, and relative humidity is between 30 and 75 percent. Temperature and relative humidity can be obtained using a sling psychrometer (Appendix B). If applied when temperature or humidity is low, the coating will not properly cure. If applied when temperature or humidity is high, the coating will dry too fast and exhibit pinholes, microblisters, or hazing in gloss films, and gloss variation (streaking) in lusterless films.

7–9.5.4. Material preparation. Both MIL–PRF–85285 and TT–P–2756 Topcoats are supplied as a two component kit. The two components must be mixed together in the proper proportions prior to use. One component contains the pigment within a polyurethane vehicle, while the other component contains the clear resin solution. These components are packaged separately and have excellent storage stability. Once mixed, however, the two components undergo a chemical reaction to achieve proper film characteristics. Over a few hours, the coating will gel and harden regardless of whether or not it is exposed to air. Pot life is a measure of the length of time a catalyzed coating remains useful for application. In general, the pot life of polyurethane topcoat is 4 hours. During hot or humid conditions, the pot life will decrease. Only mix enough material that can be used within two hours. Do not add thinner to attempt to compensate for coatings beyond useful pot life. Mix the topcoat as follows:

a. Mix the pigmented component thoroughly to ensure that the solids are completely dispersed. Use a paint shaker for approximately 10 minutes if possible. If a paint shaker is not available, use a clean metal or wooden paddle to stir the contents. After mixing, check the bottom of the container to ensure that all of the pigment is dispersed.

b. Pour the pigmented component into a clean, empty container. The empty container must be at least two times the capacity of the pigmented component.

CAUTION

Only mix materials from the same manufacturer. Never mix materials from different manufacturers. Mix the two components in the volume ratio specified by the manufacturer. Refer to the container label.

c. Pour the required amount of clear resin component slowly into the container with the pigmented component. Stir thoroughly with a metal or wooden paddle. To remain compliant with environmental regulations, do not add thinner to this material unless specifically required per manufacturer's instructions.

7–9.5.5. Spray application. After the topcoat is thoroughly stirred, strain the material through a disposable paint strainer to remove coarse particles. After mixing and straining, the material is ready for application. No induction time is required. Spray the mixed topcoat in accordance with paragraph 7–8. Two coats are necessary to achieve adequate film thickness. The first coat shall be a light (mist) coat. Allow the first coat to set for 30 to 60 minutes before applying the second coat to permit solvent evaporation. The second coat shall be a full wet coat to achieve the desired film thickness. Refer to paragraph 7–9.5.8. Apply the MIL–PRF–85285 topcoat within 24 hours of primer application. Apply TT–P–2756 within 24 hours of chemical conversion coating (MIL–C–81706) surface treatment of aluminum. If the primer has been allowed to dry longer than 24 hours but not more than 7 days, proceed as follows:

a. Clean the surface by wiping with clean cheesecloth dampened with MIL–T–81772, Type I Thinner.

b. Apply a thin (mist) coat of epoxy primer (MIL–P–23377 or MIL–PRF–85582).

c. Allow primer to dry tack–free and then apply the specified topcoat.

NOTE

To ensure proper adhesion, if the primer has dried longer than 7 days, it must be lightly scuff sanded prior to proceeding with steps a, b, and c above.

7–9.5.6. Brush or roller application. For brush or roller application, strain the topcoat per paragraph 7–9.5.4. Apply one uniform coat to the surface (refer to paragraph 7–8.5) and allow it to dry tack–free before applying an additional coat.

7–9.5.7. Touch–up pen application. For convenient touch–up of small areas, MIL–PRF–85285 High–Solids Polyurethane Coating is available in touch–up pens. Refer to paragraph 7–5.7.

7–9.5.8. Film thickness. The total dry film thickness of MIL–PRF–85285 topcoat shall be 1.7 to 2.3 mils (0.0017 to 0.0023 inches). The total dry film thickness of TT–P–2756 Self–priming Topcoat shall be 2.0 to 2.6 mils (0.0020 to 0.0026 inches). Dry film thickness can be estimated using a wet film thickness gage (Appendix B). Dry film thickness will be approximately 50 percent of the wet film thickness. Refer to paragraph 7–5.9.

7–9.5.9. Drying time. Tack–free drying time of MIL–PRF–85285 and TT–P–2756 topcoats depends upon the temperature, but is approximately 4 hours at 70_F. Tack–free means that the coating can be touched lightly with the fingertip without noticeable tackiness. At this stage of drying, the coating is not completely cured and can be easily marred. The topcoat will dry hard in approximately 12 hours at 70_F, which means the coating is fairly durable and can be handled. The coating dries slowly at lower temperatures. Complete coating system cure requires approximately 7 days. In general, the aircraft shall be handled, taxied, etc., as little as possible during the first week after painting of exterior surfaces.

7–9.6. High–Solids Epoxy Coating (MIL–PRF–22750).

WARNING

Aircraft coating materials and thinners are highly flammable. Never store, open, or apply these materials near ignition sources such as lighted cigarettes, sparks, electrical arcing, heat sources, etc. No eating, drinking, or smoking is allowed in areas where coatings or solvents are used or stored.

Personnel mixing and applying coating materials or performing equipment cleanup operations shall wear chemical or splash proof goggles, solvent resistant gloves (MIL–G–12223 or others meeting OSHA requirements), approved coveralls (A–A–55196 or MIL–C–2202), and a respirator. Consult the local Industrial Hygiene Activity for proper respirator selection and use. Avoid breathing fumes. Do not allow coating materials to contact skin or eyes.

Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. Prolonged or repeated skin contact with organic solvents can have local (skin) and systemic (internal organ) toxic effects. Consult the applicable material safety data sheet (MSDS) for additional safety information.

CAUTION

Only materials from the same kit shall be mixed, except that two or more kits from the same manufacturer may be mixed in the same vessel. Do not mix components from different manufacturers. Specified mixing ratios must be followed closely to avoid unsatisfactory film properties such as inadequate drying, poor adhesion, and poor solvent resistance.

7–9.6.1. Description. MIL–PRF–22750 epoxy topcoat (formerly MIL–C–22750) is a VOC compliant (340 G/L maximum) high–solids coating suitable as an alternate touch–up material when polyurethane topcoats are not available or cannot be used. This topcoat has excellent chemical resistance, however, it is not as flexible as polyurethane topcoat and will chalk when exposed to sunlight. Exact color matching of epoxy topcoat to polyurethane topcoat is usually poor and is aggravated by the tendency of epoxy topcoat to chalk. MIL–PRF–22750 epoxy topcoat can be applied over primers conforming to MIL–P–23377, MIL–PRF–85582, and TT–P–2760.

7–9.6.2. Temperature requirements. Ensure the temperature for each component is between 60_F and 90_F before mixing and application. Surface temperature of the area to be coated must be between 50_F and 95_F. Do not apply this material if the ambient temperature is below 50_F.

7–9.6.3. Material preparation. MIL–PRF–22750 topcoat is supplied as a two component kit. The two components must be mixed together in the proper proportions prior to use. One component contains the pigment within an epoxy vehicle, while the other component contains the clear resin solution. These components are packaged separately and have excellent storage stability. Once mixed, however, the two components undergo a chemical reaction to achieve proper film characteristics. Over a few hours, the coating will gel and harden regardless of whether or not it is exposed to air. Pot life is a measure of the length of time a catalyzed coating remains useful for application. In general, the pot life of epoxy topcoat is 4 hours. During hot or humid conditions, the pot life will decrease. Only mix enough material that can be used within two hours. Do not add thinner to attempt to compensate for coatings beyond useful pot life. Mix the topcoat as follows:

a. Mix the pigmented component thoroughly to ensure that the solids are completely dispersed. Use a paint shaker for approximately 10 minutes if possible. If a paint shaker is not available, use a clean metal or wooden paddle to stir the contents. After mixing, check the bottom of the container to ensure that all of the pigment is dispersed.

b. Pour the pigmented component into a clean, empty container. The empty container must be at least two times the capacity of the pigmented component.

CAUTION

Only mix materials from the same manufacturer. Never mix materials from different manufacturers. Mix the two components in the volume ratio specified by the manufacturer. Refer to the container label.

c. Pour the required amount of clear resin component slowly into the container with the pigmented component. Stir thoroughly with a metal or wooden paddle. To remain compliant with environmental regulations, do not add thinner to this material unless specifically required per manufacturer’s instructions.

7–9.6.4. Spray application. After the epoxy topcoat is thoroughly stirred, strain the material through a disposable paint strainer to remove coarse particles. Prior to spraying, allow the mixed topcoat to stand for approximately 30 minutes. This induction period is necessary to allow components to partially react. Spray the mixed topcoat in accordance with paragraph 7–8. To achieve the desired film thickness, two coats are usually required. The first coat shall be a light (mist) coat. Allow the first coat to set for 30 to 60 minutes before applying the second coat to permit solvent evaporation. The second coat shall be a full wet coat to achieve the desired film thickness. Refer to paragraph 7–9.6.6. Apply the epoxy topcoat within 24 hours of primer application. If the primer has been allowed to dry longer than 24 hours but not more than 7 days, proceed as follows:

a. Clean the surface by wiping with clean cheesecloth dampened with MIL–T–81772, Type I Thinner.

b. Apply a thin (mist) coat of epoxy primer (MIL–P–23377 or MIL–PRF–85582).

c. Allow primer to dry tack–free and then apply the epoxy topcoat.

NOTE

To ensure proper adhesion, if the primer has dried longer than 7 days, it must be lightly scuff sanded prior to proceeding with steps a, b, and c above.

7–9.6.5. Brush or roller application. For brush or roller application, strain the epoxy topcoat and allow it to stand for 30 minutes as per paragraph 7–9.6.4. Apply one uniform coat to the surface (refer to paragraph 7–8.5) and allow it to dry tack–free before applying an additional coat to achieve the desired film thickness.

7–9.6.6. Film thickness. The total dry film thickness of epoxy topcoat shall be 1.7 to 2.3 mils (0.0017 to 0.0023 inch). Dry film thickness can be estimated using a wet film thickness gage. Dry film thickness will be approximately 50 percent of the wet film thickness. Refer to paragraph 7–5.9.

7–9.6.7. Drying time. Tack–free drying time of MIL–PRF–22750 topcoat depends upon the temperature, but is generally between 2 and 6 hours. At 70_F, the material will be tack–free in less than 5 hours. Tack–free means that the coating can be touched lightly with the fingertip without noticeable tackiness. At this stage of drying, the coating is not completely cured and can be easily marred. MIL–PRF–22750 primer will dry hard in approximately 8 hours at 70_F, which means the coating is fairly durable and can be handled. Epoxy topcoat dries slowly at lower temperatures.

7–9.7. Acrylic Lacquer Topcoat (MIL–PRF–81352, Type I).

WARNING

Aircraft coating materials and thinners are highly flammable. Never store, open, or apply these materials near ignition sources such as lighted cigarettes, sparks, electrical arcing, heat sources, etc. No eating, drinking, or smoking is allowed in areas where coatings or solvents are used or stored.

Personnel applying coating materials or performing equipment cleanup operations shall wear chemical or splash proof goggles, solvent resistant gloves (MIL–G–12223 or others meeting OSHA requirements), approved coveralls (A–A–55196 or MIL–C–2202), and a respirator. Consult the local Industrial Hygiene Activity for proper respirator selection and use. Avoid breathing fumes. Do not allow coating materials to contact skin or eyes.

Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. Prolonged or repeated skin contact with organic solvents can have local (skin) and systemic (internal organ) toxic effects.

Consult the applicable material safety data sheet (MSDS) for additional safety information.

7–9.7.1. Description. MIL–PRF–81352, Type I, acrylic lacquer coating (formerly MIL–L–81352) can be used for application of temporary markings/MODEX where environmental regulations permit. Lacquer coatings dry by solvent evaporation. These coatings are easily applied, however, they are not very durable and are not resistant to operational fluids and some cleaning compounds. For application of markings, lacquer is generally applied over clean, lightly scuff sanded topcoats. In areas where lacquer is not permitted, use only VOC compliant coatings conforming to MIL–PRF–85285, Type I, or TT–P–2756 polyurethane topcoats, or MIL–PRF–22750 epoxy topcoat. Lacquer coatings do not provide sufficient durability for use as a touch–up material for conventional coatings.

7–9.7.2. Material preparation. MIL–PRF–81352, Type I, acrylic lacquer is available in quart, gallon, and aerosol (pint) containers. Quarts and gallons should be thoroughly mixed using a paint shaker if possible, to completely disperse the solids. Refer to manufacturer's instructions for obtaining the appropriate spray viscosity.

7–9.7.3. Spray application. Dry film thickness of lacquer shall be 1.5 to 2.0 mils (0.0015 to 0.0020 inches), which can be obtained by applying two wet coats. Allow approximately 15 minutes dry time between coats. The underlying paint coating should not be visible through the dried film. These coatings will dry hard within two hours.

7–9.7.4. Brush and roller application. Application of lacquer by brush or roller is not recommended but can be used when spray application is not permitted.

7–9.8. Specialty coatings. Many aircraft require the use of specialty coatings for operational or functional requirements beyond the scope of standard primer/topcoat paint systems. Specialty coatings include Rain Erosion Resistant Coating, Teflon Filled Anti–chafe Coating, Electrically Conductive Coating, Non–slip Walkway Coating, Heat Resistant Coating, etc. Refer to specific maintenance instructions for coating requirements applicable to individual weapons systems. Some of the more common specialty coatings are described below.

7–9.8.1. Rain Erosion Resistant Coatings (MIL–C–83231, MIL–C–85322, etc). Rain erosion resistant coatings are used to protect leading edges, particularly fiber–reinforced plastic surfaces, from erosion due to exposure to the air stream during flight. Many of these materials consist of polyurethane resins and, therefore, may pose health risks due to isocyanates. As stated in paragraph 7–9.5.2, isocyanate vapors, even in very small concentrations, can produce significant irritation of the skin, eyes, and respiratory tract and may also induce allergic sensitization of personnel. Personnel using these materials shall consult OPNAVINST 5100.23 for specific details. Refer to specific maintenance instructions for information concerning the selection and use of rain erosion resistant coatings. Consult manufacturer's data supplied with the material for safety, mixing, and application instructions.

7–9.8.2. Anti–chafe coatings. These Teflon t filled coatings are generally proprietary materials used to protect surfaces that may rub against other surfaces. This material is available in several colors, including the common gray colors used with tactical paint schemes. It is supplied as a two component kit that must be mixed together in the proper proportions prior to use. Refer to specific maintenance instructions for information concerning the selection and use of anti–chafe coatings. Consult manufacturer's data supplied with the material for safety, mixing, and application instructions.

7–9.8.3. Black Conductive Coating (P/N: 8–B–6). This material is used as a protective coating on fiber–reinforced plastic parts, such as radomes and helicopter rotor blades, to provide erosion protection and dissipate static electricity. Refer to specific maintenance instructions for information concerning the selection and use of black conductive coatings. Consult manufacturer's data supplied with the material for safety, mixing, and application instructions.

7–9.8.4. Non–slip Walkway Coating (A–A–59166; formerly MIL–W–5044). This material is used as a slip resistant coating for specific aircraft surfaces. This coating is supplied as a single component material and is available in two types: Type I has a smooth texture; Type II has a rough, gritty texture. Both types are usually applied by brush and are available in a variety of colors, including many of the common gray colors used with tactical paint schemes. Refer to specific maintenance instructions for information concerning the selection and use of non–slip walkway coatings.

7–9.8.5. Heat Resistant Coating (TT–P–28). This is an aluminum pigmented coating resistant to temperatures up to 1200_F. It is generally used on surfaces exposed to temperatures in excess of the tolerance of standard paint systems. It is supplied as a single component and can be applied by brush or spray. After application, allow the coating to air dry for 30 minutes followed by baking at 400_F (204_C) for one hour. If baking is not possible after air drying, the coating may be cured during component use at elevated temperature. Refer to specific maintenance instructions for information concerning the use of heat resistant coating.

CHAPTER 8

TREATMENT OF SPECIFIC AREAS

8–1. INTRODUCTION. This section describes the procedures recommended for treating and protecting against corrosion in specific areas. The following paragraphs describe the treatment of corrosion prone areas and contain illustrations to aid in inspections. However, this section is not complete and should be amplified and expanded by reference to the applicable maintenance instruction manuals for specific aircraft.

WARNING

Observe precautions listed in previous chapters (or references) for cleaning compounds, solvents, surface treatments, sealants and paints.

8–2. BATTERY COMPARTMENTS, BOXES, AND ADJACENT AREAS. The battery, battery cover, battery box, and adjacent areas (especially areas below the battery compartment where battery electrolyte may have seeped) are subject to the corrosive action of electrolyte. Two different types of batteries are encountered on aviation equipment: lead acid, having a sulfuric acid electrolyte; and nickel–cadmium, having a potassium hydroxide electrolyte. Alternative methods for neutralizing electrolytes are given in Table 3–1.

8–2.1. Preparation of solutions for cleaning and neutralizing battery electrolytes.

WARNING

When handling electrolytes, splash proof goggles, rubber gloves, and rubber aprons shall be worn. If any electrolyte contacts the skin or eyes, flood the affected area immediately with water and consult the Base Medical Service. An emergency shower and an eye wash station in the area where work is being performed are required.

Isopropyl Alcohol (TT–I–735) is highly flammable.

CAUTION

Both sulfuric acid and potassium hydroxide battery electrolytes will cause severe corrosion of metallic structure. Avoid dripping electrolyte on or allowing contaminated gloves, rags, sponges, etc. to come in contact with aircraft structure. Place all items contaminated with electrolyte in a leak–proof plastic container prior to removing them from the aircraft. Remove any battery box which contains spilled electrolyte from the aircraft prior to cleaning it. Electrolyte spilled on aircraft structure shall be cleaned up as soon as possible after it has been detected.

NOTE

The use of indicating solutions can be avoided by using test strips of litmus paper. When trying to detect electrolyte spills from acid batteries (such as lead acid), apply a strip of blue litmus paper to the wet surface. A color change to red indicates an acid is present. When trying to detect spills from alkaline batteries (such as nickel–cadmium), apply red litmus paper to the wet surface. A color change to blue indicates an alkaline solution is present.

8–2.1.1. Indicating solutions (litmus solution for lead acid batteries and bromothymol blue solution for nickel–cadmium batteries) are required for cleaning areas subjected to electrolyte spills to determine the location of contaminated areas and to indicate if these areas have been completely neutralized. Use a 10 percent sodium bicarbonate (ordinary baking soda) solution to neutralize sulfuric acid from lead acid batteries and a distilled white vinegar solution to neutralize potassium hydroxide from nickel–cadmium batteries.

8–2.1.2. Litmus indicating solution. Pour one pint of a mixture containing 70 percent by volume of isopropyl alcohol (TT–I–735) and 30 percent by volume of distilled water into a plastic bottle with a hand squeeze pump. Add one tablespoon of litmus powder into the solution, and mix thoroughly until a deep blue color is observed.

8–2.1.3. Bromothymol blue indicating solution. Pour one pint of bromothymol blue solution into a plastic bottle with a hand squeeze pump. Using an eye dropper, add one drop of phosphoric acid into the solution (with subsequent mixing after each drop) until the color of the solution changes from blue to gold or amber.

8–2.1.4. Sodium bicarbonate neutralizing solution. Pour one pint of fresh water into a 500–mL polyethylene wash bottle, add two ounces of sodium bicarbonate (ASTM D928) and mix thoroughly.

8–2.1.5. Boric acid neutralizing solution. Pour one pint of fresh water in a 500–mL polyethylene wash bottle, add one–half ounce of boric acid powder (A–A–59282) and mix thoroughly.

8–2.2. Cleaning and neutralizing procedures.

a. Remove any standing liquid or puddles with a squeeze bulb type syringe, absorbent cloth, or sponge. Place the used items in a leak–proof container for disposal to prevent the contamination of other areas.

b. Spray the entire suspected area with the proper indicator solution, using the minimum amount needed to wet the entire surface. For spills from lead acid batteries, use the litmus solution which will change in color from deep blue to a bright red in areas contaminated by sulfuric acid. For spills from nickel–cadmium batteries, use the bromothymol blue solution which will change in color from amber or gold to a deep blue in areas contaminated by potassium hydroxide.

c. Apply the correct neutralizing solution to the areas where the indicating solution has been applied. Ensure that the area is well–saturated including all seams and crevices where electrolyte could collect. Use care to prevent neutralizing solutions from spreading to adjacent areas, and ensure that bilge area drains are open to allow fluids to flow overboard. Allow the neutralizing solution to remain on the surface for at least five minutes or until all bubbling action ceases, whichever is longer.

d. Rinse the area thoroughly with a liberal amount of clean water and remove any standing liquid or puddles, as specified in step a.

e. Reapply the indicator solution, as in step b. If the solution does not change color, rinse the area, as in step d., and dry the areas with clean cloths or rags. If the solution changes color, repeat steps c. and d.

f. Apply conversion coating treatment (Chapter 5), sealant (Chapter 6), and paint coatings (Chapter 7).

8–2.3. Paint systems. Special acid and/or alkali resistant coatings are usually required for battery compartments, boxes, and areas. Refer to the applicable aircraft manuals.

8–3. RELIEF TUBE AREAS. Interior and exterior relief tube areas shall be inspected and cleaned after each flight. Cleaning shall be accomplished by procedures outlined in Chapter 3. After cleaning, the areas shall be treated with a disinfectant (O–D–1435 or TT–I–735). After cleaning and disinfecting, if the treated areas have exposed bare metal, apply conversion coating material for the specific metal or alloy as outlined in Chapter 5.

8–4. CORROSION TREATMENT FOR STEEL CABLES.

CAUTION

Consult maintenance manuals for cable detensioning and tensioning requirements prior to performing any maintenance.

NOTE

Do not use metallic wools to clean installed cables. The use of metallic wool will cause dissimilar metal particles to become embedded in the cables and create further corrosion problems (galvanic corrosion). To clean control cables, use only a clean cloth dampened with dry cleaning solvent (MIL–PRF–680, Type II). Excessive solvent will remove internal cable lubricant and thus allow cable strands to abrade and further corrode.

8–4.1. If the surface of a cable is corroded, relieve cable tension and carefully force the cable open by reverse twisting. Visually inspect the interior. Corrosion on the interior strands constitutes failure, and the cable must be replaced. If no internal corrosion is detected, remove loose external rust and corrosion with a clean, dry, coarse-weave rag or fiber brush. To clean control cables, use only a clean cloth dampened with dry cleaning solvent (MIL-PRF-680, Type II). After thorough cleaning, apply MIL-PRF-16173, Grade 4 corrosion preventive compound (CPC) liberally. Wipe off excess. If excessive CPC is allowed to build up, it will interfere with the operation of cables at fair-leads, pulleys, or grooved bellcrank areas.

8-5. PIANO TYPE HINGES. Corrosion inhibiting solid film lubricants are often applied to hinge pins and nodes to provide lubrication and to reduce corrosion problems. See Chapter 3 for procedures on touch-up and replacement of these lubricants when hinges are disassembled. Each time equipment is washed, make sure all hinges are cleaned in accordance with Chapter 3. After washing, apply a coating of a water displacing corrosion preventive compound. Use either MIL-L-63460, or MIL-C-81309 Type II and VV-L-800 to the node and hinge pin areas of all piano hinges including those coated with solid film lubricants.

8-6. INTEGRAL AND EXTERNAL FUEL TANKS AND DROP TANKS. For Navy materials and procedures, see NAVAIR 01-1A-35. For Army materials and procedures, see TM 55-1500-204-25/1 or applicable maintenance manuals. For Air Force materials and procedures, see T.O. 1-1-3.

8-7. FAYING SURFACES AND ATTACHMENT POINTS.

NOTE

Treat and process faying surfaces of parts, components, or structures which are assembled by adhesive bonding in accordance with the applicable equipment structural repair manual for adhesive bonding.

8-7.1. Faying surfaces, joints, and seams. When repairs are made on equipment or accessories and components are installed or structures are reinstalled, the attaching or faying surfaces shall be protected by sealing all metal to metal contacts and composite to metal contacts. All permanent structures shall be installed with MIL-PRF-81733 sealant at the faying surface. All removable structure (components requiring frequent removal for maintenance requirements) shall be installed at the faying surfaces with AMS 3367 or PR-1773, Class B sealant. Fillet seal all exterior seams (those exposed to the outside environment) of permanent structure to make it flush with the adjoining surface using MIL-PRF-81733 sealant, and fillet seal all exterior seams on removable structure with AMS 3367 or PR-1773, Class B sealant (see Chapter 6 for details on sealant application). The coating system on all attaching parts shall be touched up after installation to match the surrounding structure in accordance with Chapter 7 (Navy), T.O. 1-1-8 (Air Force), and TM 55-1500-345-23 (Army).

8-7.2. Attaching parts and hardware.

NOTE

The following does not apply to parts which are lubricated in the joint areas immediately before or after installation, or to close tolerance bolts and parts which are removed frequently for maintenance requirements.

a. Attaching parts, such as nuts, bushings, spacers, washers, screws, self-tapping screws, sleeves for shake-proof fastener studs, self-locking nuts, speed nuts, clamps, bolts, etc., do not need to be painted in detail except when dissimilar metal or wood contact is involved with the materials being joined. However, all parts shall be installed wet with sealant. For permanent installations, use MIL-PRF-81733 sealant and coat the entire mating surface of the parts. For removable installations, use AMS 3367 or PR-1773, Class B sealant and coat only the lower side of the heads of screws and bolts with sealant. For removable installations, do not coat the threads and shanks of screws and bolts or the holes into which they are inserted because this will make future removal almost impossible without damaging the parts.

b. Close tolerance bolts and parts shall be coated with corrosion inhibiting solid film lubricant. Use MIL-L-46010 (heat curing) on non-aluminum parts when 400_F (204_C) ovens are available. Use MIL-L-23398 (air curing) on aluminum parts and on all types of metallic parts when 400_F ovens are unavailable. The solid film lubricant shall be applied and completely cured prior to assembly. Bolts shall be coated on shanks and threads only. A thin bead of sealant shall be applied under the bolt head to impart a wet seal. If possible, bolt head, nut, and end shall be fillet sealed with MIL–PRF–81733 sealant after installation.

c. All rivets shall be installed wet with MIL–PRF–81733 sealant, except those in fuel contact areas.

d. All machine screws, countersunk fasteners, bolts (head end) and nuts which are used in contact with magnesium shall be installed with 5056 aluminum alloy washers. These parts and washers shall be installed wet with MIL–PRF–81733 sealant and shall be completely fillet sealed with the same material after installation.

e. Adjustable parts, such as tie rod ends and turnbuckles:

(1) If possible, surfaces and threads shall be lubricated and protected before assembly with corrosion inhibiting solid film lubricant (MIL–L–46010 or MIL–L–23398) which shall be completely cured prior to assembly. After installation, apply a thin coating of DOD–L–25681 lubricant to all surfaces of these parts located in high temperature areas, or a thin coating of a water displacing, corrosion preventive compound (MIL–C–81309, Type II) to all surfaces of these parts located in other areas.

(2) If solid film lubricants cannot be applied, use a thin coating of DOD–L–25681 lubricant on all surfaces before and after assembly when located in high temperature areas. Apply a thin coating of a water displacing lubricant (VV–L–800) before assembly, followed by a thin coat of a corrosion preventive compound (MIL–C–81309, Type II) after assembly when located in other areas.

f. Slip fit parts shall be assembled with mating surfaces using MIL–PRF–81733 sealant. If not possible, coat the ID of the hole in the receiving part, which is normally the larger structure with MIL–L–23398 and coat the OD of the mating part with MIL–L–46010 or MIL–L–23398. The solid film lubricant shall be applied and completely cured prior to assembly.

g. Press fit parts shall be installed with faying surfaces using MIL–PRF–81733 sealant, and the edges of these parts shall be fillet sealed with the same sealant after installation. The sealant should also be applied to the ID of the hole into which the part will be installed.

h. All cut edges and holes drilled or reworked for bolts, screws, rivets, studs, and bushings of aluminum and magnesium structure or parts shall receive a chemical conversion coating treatment prior to the installation of the fasteners or bushings and prior to installing or refinishing the structure or parts. Apply MIL–C–81706, Class 1A to aluminum parts and AMS–M–3171, Type VI to magnesium parts in accordance with Chapter 5, Section II.

8–7.2.1. <u>Severely corroded (rusted) hardware.</u> Severely corroded screws, bolts, and washers shall be replaced. When a protective coating, such as cadmium plating on bolts, screws, etc. is damaged, immediate action shall be taken to apply an appropriate protective finish to prevent corrosion (rusting). Refer to Chapter 3 for proper corrosion preventative materials.

8–8. RUBBER, NATURAL AND SYNTHETIC. Natural and synthetic rubber shall not be painted or oiled. As a general rule, grease should not be applied to rubber parts, but some parts, such as “O” rings, require a grease coating (consult the appropriate maintenance manual). Many types of rubber are subject to fungus growth (e.g. mold, mildew) which can cause deterioration of the rubber and corrosion of surrounding metal surfaces. If fungus is noted on rubber parts, clean the parts and remove the fungus in accordance with Chapter 3.

8–9. POTABLE WATER TANKS. The interior surfaces of aluminum alloy potable water tanks shall not be painted or conversion coated. Remove corrosion by using the mechanical methods outlined in Chapter 5, and ensure all debris is removed.

8–10. SURFACES AND COMPONENTS EXPOSED TO EXHAUST GASES, GUN GASES, AND ROCKET BLAST. Residues from exhaust gases, gun gases, and rocket blast are very corrosive and can cause deterioration of paint systems. Frequent cleaning of these areas to remove residue is required and shall be accomplished in accordance with Chapter 3.

8–11. ELECTRICAL AND ELECTRONIC EQUIPMENT. Avionic and electrical equipment are easily damaged by contamination with corrosion removal debris and by application of improper corrosion control materials. Many of the conventional corrosion treatment methods used on airframe components are also used on areas adjacent to or supporting avionic equipment, electrical equipment, wire bundles, and other electrical parts. Personnel performing airframe corrosion control tasks shall be familiar with avionic corrosion control materials and procedures to ensure that no damage to electrical or avionic equipment will occur. For more specific information, refer to the following manuals: Navy (NAVAIR 16-1-540), Army (TM 55-1500-343-23), and Air Force (T.O. 1-1-689, T.O. 00-25-234, T.O. 1-1A-14) as well as the specific equipment maintenance manuals.

8-11.1. Grounding and bonding connections. After the grounding or bonding connection has been made, overcoat the entire connection, including all bare areas on the metal surface, with MIL-PRF-81733 sealant.

8-11.2. Conduit and junction boxes. Electrical conduit (exterior) and junction boxes (interior and exterior) shall be primed with two coats of epoxy primer (MIL-P-23377 or MIL-P-85582) in accordance with Chapter 7 (Navy) T.O. 1-1-8 (Air Force), or TM 55-1500-345-23 (Army). If corrosion is found, remove by mechanical methods outlined in Chapter 5. Before applying primer, reworked and bare metal areas shall be treated with MIL-C-81706, Class 1A for aluminum alloy parts or AMS-M-3171, Type VI for magnesium alloy parts.

8-11.3. Wires and cables. Electrical wires and cables having plastic jacket insulation or braided wire exterior shielding shall not be painted except as required for moisture and fungus proofing (see the references listed in paragraph 8-11).

8-11.4. Corrosion protection for electrical connectors, lead-ins, etc. Almost all corrosion problems on electrical and electronic equipment are caused by moisture intrusion at the connector or lead-in attachment points on cases and covers. While the design of this equipment is fixed, corrosion can be prevented by spraying MIL-C-81309, Type III corrosion preventive compound into the pin and/or pin receptacle end of connectors prior to mating the connector halves and on the connector shells after mating the connector halves. Consult NAVAIR 16-1-540 or T.O. 1-1-689 for additional information.

8-11.5. Moisture and fungus proofing of electrical and electronic equipment. See the references listed in paragraph 8-11.

8-11.6. Antennas. Dissimilar metal corrosion (i.e., galvanic corrosion) often occur at antenna attachment points. Refer to NAVAIR 16-1-540 or T.O. 1-1-689 for repair information and to the maintenance instruction manuals for information on paint touch-up and finishing.

8-12. STRUCTURAL TUBING MEMBERS AND ASSEMBLIES. Only non-powered mechanical procedures and materials specified in Chapter 5 shall be used to remove corrosion on structural tubing. Reworked areas shall always be polished to a smooth surface, using 400 to 600 grit abrasive paper or cloth, as the final step in the corrosion removal procedure. The following steps outline general practices for the protection of structural tubing.

8-12.1. Structural aluminum alloy tubing. Treat and paint the exterior surfaces of all tubing and the interior surfaces of open ended tubing and tubing closed off by riveted or bolted end surfaces with the finish system designated in the applicable maintenance manual. Paint in accordance with Chapter 7 (Navy), T.O. 1-1-8 (Air Force), or TM 55-1500-345-23 (Army). All bolted or riveted caps or components shall be installed with faying surfaces and fasteners wet using MIL-PRF-81733 sealant. Interior surfaces of tubing closed by welded end plugs or components shall be coated with a corrosion preventive compound (MIL-PRF-16173, Grade 2 or 4) using the fill-and-drain method of application through holes located near each end of the tubes. These holes shall subsequently be closed by installing blind rivets using MIL-PRF-81733 sealant and overcoating the rivet head with the same after installation.

8-12.2. Structural magnesium alloy tubing. All surfaces of tubing shall be treated with a magnesium conversion coat (AMS-M-3171, Type VI) in accordance with Chapter 5 and painted with the finish system designated in the relevant equipment maintenance manual. Install all parts onto the tubing with all faying surfaces and fasteners wet with MIL-PRF-81733 sealant.

8-12.3. Structural copper alloy, stainless steel alloy, and heat resistant alloy tubing. The interior and exterior surfaces of these types of tubing do not require a finish system. However, to prevent galvanic corrosion of other metals with which these types of tubing are in contact, install parts and attach tubing with faying surfaces and fasteners wet using MIL–PRF–81733 sealant or AMS–3374 sealant for high temperature areas.

8–12.4. Structural carbon steel tubing.

a. Exterior. All exterior surfaces of steel tubing assemblies shall be finished with one coat of MIL–P–23377 or MIL–PRF–85582 primer followed by two coats of MIL–PRF–85285 polyurethane topcoat. The topcoat color is specified in the applicable maintenance manual. Apply primer and topcoat materials in accordance with Chapter 7 (Navy), T.O. 1–1–8 (Air Force), or TM 55–1500–345–12 (Army).

b. Interior. For tubing assemblies without welded or crimped ends, coat all interior surfaces with MIL–P–23377 or MIL–PRF–85582 primer using a fill–and–drain procedure. Where practical, in lieu of fill–and–drain procedure, two coats of primer may be spray applied to interior surfaces of all assemblies.

c. After coating the interior, clean the exterior surfaces of all assemblies to remove any residue primer. Seal all holes in tube walls by installing blind rivets in the holes while wet with MIL–PRF–81733 sealant and overcoating the rivet heads with the same after installation. Assemble all tubing assemblies manufactured by riveting or bolting members together on fittings with faying surfaces and fasteners wet with MIL–PRF–81733 sealant.

8–13. NON–STRUCTURAL TUBING MEMBERS AND ASSEMBLIES. Use the same procedures and materials specified for corrosion removal on structural tubing members and assemblies in paragraph 8–12 to remove corrosion.

8–13.1. Aluminum tubing.

WARNING

Do not use dry cleaning solvent (MIL–PRF–680, Type II) or other solvents that are not oxygen compatible on areas of oxygen storage including transfer systems and on the surfaces of missiles using liquid propellant. Failure to observe these precautions can result in serious or fatal injury to personnel.

8–13.1.1. Protect aluminum tubing exposed directly to the outside environment during either flight or ground operations by applying the exterior finish system specified in the applicable maintenance manual. Treat aluminum tubing according to the following procedure.

a. Clean in accordance with Chapter 3.

b. Remove corrosion in accordance with paragraph 8–12, using non–powered mechanical methods specified in Chapter 5.

c. Apply chemical conversion coating (MIL–C–81706, Class 1A) to all interior and exterior surfaces of tubing; coat only the exterior surfaces of aluminum alloy oxygen lines. Apply conversion coating to the entire tube after fabrication and prior to the installation of new tubes. If corrosion has been removed from tubing, apply conversion coating to all bare, reworked areas.

CAUTION

No paint or corrosion preventive compound shall be applied to any tubular interior surfaces. Take necessary precautions to prevent primer or paint from entering the interior areas of tubing. Where double flares are used (e.g., oxygen systems), cap the end and apply the finish system after the flaring operation. Paint end fittings after installation on the aircraft or equipment. Use extreme care to prevent the contamination of interior surfaces of hydraulic, oxygen, and air speed indicator tubing during painting operations.

d. No paint or corrosion preventive compound shall be applied to any interior surfaces of non–structural tubing. Apply the specified exterior finish system to all exterior surfaces or reworked areas of tubing exposed to the environment in the same sequence given above for interior tubings. Touch–up any coating systems damaged during tubing installation. Paint in accordance with Chapter 7 (Navy), T.O. 1–1–8 (Air Force), or TM 55–1500–345–23 (Army).

8–13.2. Stainless steel tubing.

WARNING

Do not use dry cleaning solvent (MIL–PRF–680, Type II) or other solvents that are not oxygen compatible on areas of oxygen storage including transfer systems and on the surfaces of missiles using liquid propellant.

AMS 3166 wipe solvent is flammable and toxic to the skin, eyes, and respiratory tract. Eye and skin protection is required. Use only in a well ventilated area.

Apply a small amount of AMS 3166 solvent to a clean cloth and wipe surface. Follow by wiping with a clean cloth or dry rag. To control solvent odor, used rags should be immediately placed in sealed plastic bags or covered containers and disposed in accordance with local directives.

8–13.2.1. Protect stainless steel tubing exposed directly to the outside environment, either during flight or ground operations, by applying a specified exterior finish (consult the applicable maintenance manual). Austenitic (3XX series) stainless steels are highly susceptible to pitting, crevice corrosion, and stress corrosion cracking when exposed to moist, salt–laden air and when deposits of dirt and debris are allowed to collect on tubing areas covered by metal brackets or parts. Treat stainless steel tubing according to the following procedure.

a. Clean in accordance with Chapter 3.

b. Remove corrosion in accordance with paragraph 8–12, using non–powered mechanical methods specified in Chapter 5.

c. Immediately before painting, wipe areas which will be painted with a lint free cloth moistened with AMS 3166 wipe solvent, and dry with a clean cloth. Do not allow drying by evaporation, since soils will redeposit on the surface.

d. Apply the specified finish system for stainless steel tubing (see paragraph 8–13.1.1.d for references).

8–13.3. Cadmium plated steel tubing.

WARNING

AMS 3166 wipe solvent is flammable and toxic to the skin, eyes, and respiratory tract. Eye and skin protection is required. Use only in a well ventilated area.

Apply a small amount of AMS 3166 solvent to a clean cloth and wipe surface. Follow by wiping with a clean cloth or dry rag. To control solvent odor, used rags should be immediately placed in sealed bags or covered containers and disposed per local directives.

8–13.3.1. Bare cadmium plating deteriorates rapidly when subjected to abrasion, most bases (alkali) and acids, and marine, industrial, and very humid environments. It should always be protected with a paint system to prevent corrosion. Treat cadmium plated steel tubing according to the following procedure.

a. Clean in accordance with Chapter 3.

b. Remove deteriorated plating and corrosion on base metal (steel) in accordance with paragraph 8–12, using non–powered mechanical methods specified in Chapter 5.

c. Immediately before painting, wipe areas which will be painted with a lint free cloth moistened with AMS 3166 wipe solvent, and dry with a clean cloth. Do not allow drying by evaporation, since soils will redeposit on the surface.

d. Apply the specified finish system for steel tubing (see paragraph 8–13.1.1.d for references).

8–13.4. Special instructions for tubing fittings and sleeves. Corrosion often occurs on sleeves and their fittings or on the tubing in contact with them, due to the crevices present at their attachment points. Galvanic corrosion often occurs because the type of sleeve or fitting chosen is not electrochemically compatible with the tubing. When corrosion is found on these areas, or when tubing, fittings, or sleeves are replaced, consult the applicable maintenance manual to determine the proper types of sleeves and fittings. Fillet seal all fittings located in areas which are inaccessible for inspection and refinishing during operational service at the joint area with MIL–PRF–81733 sealant at the time of installation and prior to painting. After the sealant is tack–free, paint the tubing, fittings, and sealant as directed in paragraph 8–13.1.1.d.

8–13.5. Removable installations.

WARNING

Do not use MIL–PRF–16173 corrosion preventive compounds on any oxygen line fittings. This material contains petroleum solvents which are not liquid oxygen (LOX) compatible. Explosion may occur if oxygen contacts this material and if the resulting mixture is subjected to sudden pressure or impact. After installation, apply the exterior paint system to exposed tubing, sleeves, and back portions of the B nuts of these fittings.

Provide adequate ventilation when using dry cleaning solvent (MIL–PRF–680, Type II). Avoid repeated or prolonged skin contact or inhalation of vapors.

8–13.5.1. Do not apply the finish system on fittings and adjacent tubing for a distance of one inch from the back end of the fittings on tubing areas requiring periodic removal and/or opening during service. Clean all old preservative coatings and dirt from the fitting, sleeves, and tubing ends with dry cleaning solvent (MIL–PRF–680, Type II) before reinstalling tubing and tightening fittings. Except for oxygen line fittings, apply a water displacing, corrosion preventive compound (MIL–C–81309, Type II) by spray or brush to all fitting surfaces after they are tightened, including the exposed areas of the sleeves and the unfinished areas of the tubing. Allow the CPC to dry for at least one hour, and apply MIL–PRF–16173, Grade 4 or MIL–C–85054 over the same area by spraying or brushing.

8–14. CORROSION REMOVAL FROM THIN METAL (0.0625 INCH THICKNESS AND LESS).

CAUTION

Do not allow metallic or corrosion particles to build up around the polishing area or polishing tool (cloth or grit paper) during the polishing operation. Damage to thin metal may result.

8–14.1. Severe pitting, intergranular, and exfoliation corrosion on thin metal requires removal by mechanical methods specified in Chapter 5 as appropriate for the type of metal involved. Use extreme care and consult the applicable maintenance manual for structural damage limits when removing corrosion from thin metal. When stains, surface corrosion, and mild to moderate pitting are found on thin structural skins (i.e., aircraft and missile skins), chemical methods, as appropriate to the type metal involved, are authorized for Army (Appendix D) and Air Force (Appendix E) personnel. Chemical methods are not authorized for Navy use. A convenient and effective mechanical method for the removal of minor corrosion or stains on all metals is as follows:

a. Mix ground pumice abrasive (SS–P–821) with clean tap water to form a paste. Using a clean, soft cloth (such as cheesecloth, A–A–1491), apply the paste to the area being treated and abrade the area with a light rubbing motion.

b. When pumice has dried to a white powder, wipe off with a clean, dry, soft cloth. If corrosion products (observed as stubborn stains) still exist, use number 600 grit wet or dry abrasive paper and water to remove the remaining corrosion. Wipe clean with a clean, soft, dry cloth.

c. Refer to Chapter 5 for the required surface treatment and finish system, and paint in accordance with Chapter 7 (Navy), T.O. 1–1–8 (Air Force), or TM 55–1500–345–23 (Army).

8–15. AIR INTAKE DUCTS FOR JET AIRCRAFT. Air intake ducts are fabricated from materials (usually 5000 series aluminum) which have high corrosion resistance. Certain components of these ducts may be cast aluminum or magnesium. Frequent cleaning of the ducts is usually sufficient to preclude attack by corrosion. Aircraft performing low level missions or take–off and landings over salt water or in highly saline atmospheres may need the ducts painted to reduce corrosion attack. A requirement for a coating as determined by the operating activity shall be coordinated with the parent service organization. The standard epoxy primer/polyurethane topcoat paint system is recommended for painting the ducts.

NOTE

These requirements do not apply to springs operating in oil or hydraulic fluids.

8–16. CLOSELY COILED SPRINGS. Springs which are so tightly coiled that the areas between the coils cannot be plated or painted for corrosion protection shall be coated with a water displacing corrosion preventive compound (MIL–C–81309, Type II) by spraying or dipping and allowed to dry for at least one hour. After drying, apply a coating of MIL–PRF–16173, Grade 4 to the springs by spraying or dipping.

8–17. CORROSION PREVENTION ON ASSEMBLIES AND PARTS REMOVED FROM AIRCRAFT DURING MAINTENANCE, 30 DAY SHORT TERM STORAGE AND OVER 30 DAY LONG TERM STORAGE REQUIREMENTS.

8–17.1. Short term storage. Short term storage shall be defined as any period up to 30 days for the purposes of this manual. When assemblies or parts are removed from the aircraft for repair, or to gain access to areas of the aircraft for maintenance, they shall be treated to prevent corrosion prior to placement into short term storage. All items shall be stored indoors in a covered area to protect them from the elements. For the Navy, refer to NAVAIR 15–01–500 or to the applicable maintenance or equipment storage manuals for specific details on storage of a particular part or assembly.

a. Assemblies or parts having bare metal surfaces, such as internal and working surfaces on landing gear components, shall be properly lubricated with the aircraft greases or oils normally applied in service.

b. High strength steel components which are stripped of their protective coatings shall have a film of corrosion preventive compound (MIL–C–81309, Type II) applied to all bare surfaces whenever there is a lapse of two hours or more in the rework cycle. The part shall then be loosely overwrapped with barrier paper (MIL–B–121, Type II, Grade A, Class 1).

c. Completely painted parts need no other special protective measures, except in marine or high humidity environments. In these cases, a CPC (MIL–C–81309, Type II) shall be applied to the part. The part shall then be loosely overwrapped with barrier paper (MIL–B–121, Type II, Grade A, Class 1).

d. Prior to rework or reapplication of protective coatings, remove “old” CPC with solvent and reapply the appropriate aircraft lubricant to areas requiring lubrication. MIL–C–81309 shall not be used for lubrication in lieu of the appropriate lubricant specified for use on a particular part or assembly.

8–17.2. Long term storage. If the storage of assemblies or parts will exceed 30 days, increased protective measures are required particularly on critical parts and high strength steel components. All items shall be stored indoors in a covered area to protect them from the elements. Refer to the following manuals, or to the applicable maintenance or equipment storage manuals, for specific details on storage of a particular part or assembly: NAVAIR 15–01–500 (Navy), T.O. 1–1–17 (Air Force), TM 743–200–1 (Army).

a. All bare metal surfaces, and surfaces with damaged plating or paint, shall be coated with water displacing corrosion preventive compound (MIL–C–81309, Type II) followed by a long term CPC (MIL–PRF–16173, Grade 4). The part shall then be overwrapped with barrier paper (MIL–B–121, Type II, Grade A, Class 1).

b. Completely painted parts need no other special protective measures, except in marine or high humidity environments. In these cases, surfaces shall be coated with water displacing CPC (MIL–C–81309, Type II) followed by a long term CPC (MIL–PRF–16173, Grade 4). The part shall then be overwrapped with barrier paper (MIL–B–121, Type II, Grade A, Class 1).

c. Depending upon the length of time in storage, reapplication of CPCs may be required. Refer to Chapter 3 for time limitation information on CPCs.

d. Prior to returning the part or assembly to service, remove CPCs with solvent and reapply the appropriate aircraft lubricant to areas requiring lubrication. CPCs shall not be used for lubrication in lieu of the appropriate lubricant specified for use on a particular part or assembly.

8–18. DEPLETED URANIUM COUNTERWEIGHTS.

WARNING

Do not abrade or sand depleted uranium under any circumstances. Depleted uranium is extremely toxic and shall be worked only under a license from the Nuclear Regulatory Commission. Machining or other work, such as surface sanding, may be done only by the licensee. No drilling, sanding, or other mechanical work is permitted on depleted uranium by any service maintenance activities. If the protective finish (plating) which covers the depleted uranium is chipped, peeled, or otherwise removed so the dark gray or black depleted uranium (or uranium oxide) is visible, the part must be returned to the licensee for rework or disposal. Packaging and shipping procedures shall conform to current regulations for handling radioactive materials.

NOTE

Refer to applicable maintenance manuals (Scheduled Depot Level Maintenance) to determine the location of depleted uranium parts. Some aircraft have depleted uranium balance weights incorporated in the airframe.

8–18.1. Mechanical removal of corrosion from depleted uranium shall not be attempted at Organizational/Unit or Intermediate level maintenance activities. If corrosion occurs, apply a liberal, continuous coat of AMLGUARD (MIL–C–85054) and contact the local radiation safety officer immediately.

8–19. MONEL RIVETS. Corrosion of nickel–copper alloy (monel) is evidenced by green corrosion products. Removal of this corrosion is not required. If desired, corrosion may be removed as follows:

a. Scrub with a brush wet with solution of one cup of sodium bicarbonate (ASTM D928) per gallon of water.

b. Thoroughly rinse the affected area with fresh water and dry with clean cloth or oil free, low pressure air.

8–20. BERYLLIUM–COPPER ALLOYS.

WARNING

Dust, corrosion products, and other fine particles generated by beryllium and beryllium–copper alloys are toxic when inhaled or allowed to contact the skin. Severe poisoning can result if beryllium dust is inhaled.

Beryllium–copper alloys shall be cleaned only in strict accordance with the following procedure or the procedure of the applicable maintenance manual.

NOTE

Surface discoloration is normal and removal is not advised.

8–20.1. To minimize the generation of fine beryllium dust particles when removing corrosion from beryllium copper fittings such as contacts, bushings, etc., by abrasive mats (A–A–58054), proceed as follows:

a. Wear disposable coveralls, gloves, hood, and cartridge respirator. Consult local safety office for requirements.

b. Dampen abrasive mat (A–A–58054) with dry cleaning solvent (MIL–PRF–680, Type II).

c. To prevent the spread of toxic dust, keep mat wet throughout the corrosion removal process.

d. Clean fitting with disposable towels dampened with dry cleaning solvent after the completion of corrosion removal.

e. Apply corrosion preventive compound MIL–C–81309, Type II, on bushings or MIL–C–81309, Type III, on contacts.

f. Wipe work area clean with disposable towels dampened with dry cleaning solvent (MIL–PRF–680, Type II).

g. Place disposable towels, abrasive mats, and coveralls in a plastic bag marked “Beryllium contaminated waste”.

h. Close plastic bag with aluminum foil tape (AMS–T–23397, Type II).

i. Discard all in accordance with local environmental protection directives.

j. Wash hands with soap and water immediately after completion of task.

8–21. EMI SEALS AND GASKETS. Radiated electromagnetic fields (produced by radar antennas, RF antennas, shipboard transmitters, certain poorly designed avionics units, electric motors, and lightning or any other natural effects) can interfere with aircraft avionics systems causing electrical malfunctions. This radiation is known as EMI (electromagnetic interference). To prevent malfunctions caused by EMI, electrically conductive shielding is either built into the avionic device or must be added to access panels, doors, or covers to: 1) prevent emission of EMI from its own circuits and; 2) prevent susceptibility to outside EMI. EMI seals and gaskets may also act as environmental seals in certain locations especially around doors and access panels. Since aluminum surfaces oxidize easily becoming less conductive, other materials have been used to make electrical contacts (i.e., beryllium–copper, titanium, silver–plated aluminum, and tin–zinc coatings). However, since these contacts must provide a conductive path to an aluminum or graphite/epoxy skin, corrosion often occurs at the junction of these dissimilar metals. When corrosion occurs, the conductive path is lost and so is the EMI protection, making the aircraft susceptible to electrical malfunctions caused by external radiation. Examples of system malfunctions are microprocessor bit errors, computer memory loss, false indicators (alarms, lights, readouts), CRT ripple, false signals and power loss. The result of such malfunctions can be catastrophic. For example, EMI radiation was responsible for an aircraft jettisoning a bomb while taking off from a carrier. The following are typical EMI shielding materials: elastomeric seals and gaskets with an embedded or attached conductor (Figure 8–1), conductive elastomer gaskets (Figure 8–2), metallic screens installed under composite covers (Figure 8–3), bonding cables for access doors (Figure 8–4), and bonding washers for avionics enclosure (Figure 8–5).

8–21.1. Treatment of EMI Seals and Gaskets. When corrosion is observed in such areas, disassemble only the affected area and remove the corrosion using the mildest available method. Carefully clean the area with cloths wet with isopropyl alcohol (TT–I–735). Dry with a clean cloth. If replacement seals are available, install them in accordance with aircraft maintenance instructions or bulletins. If replacement seals are not available or do not exist, spray the contacting surfaces with a light coating of MIL–C–81309, Type III, then reassemble. Periodically inspect repaired areas and areas known to be chronic problems.

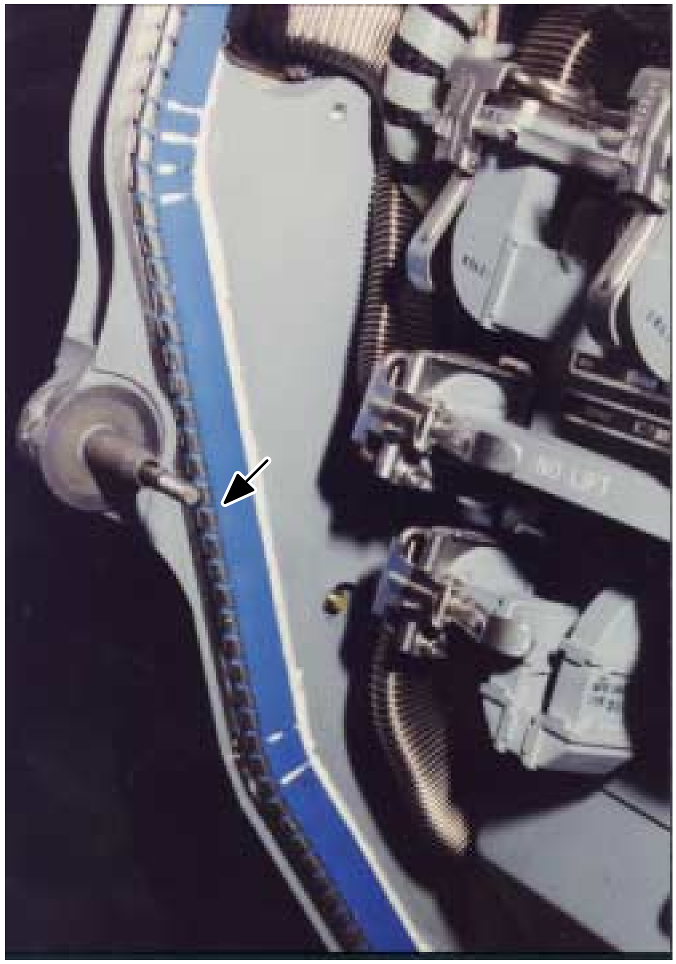


Figure 8-1. Beryllium-Copper Spiral Contact With Environmental Fluorosilicone Seal

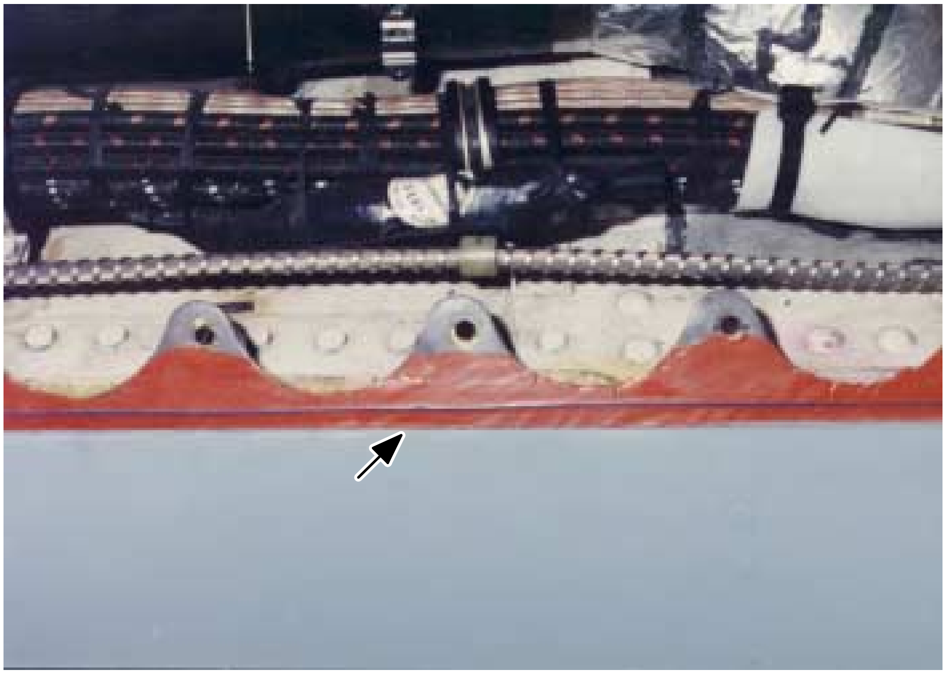


Figure 8–2. Dorsal Longeron EMI Seal

Figure 8–3. Stainless Steel EMI Screen

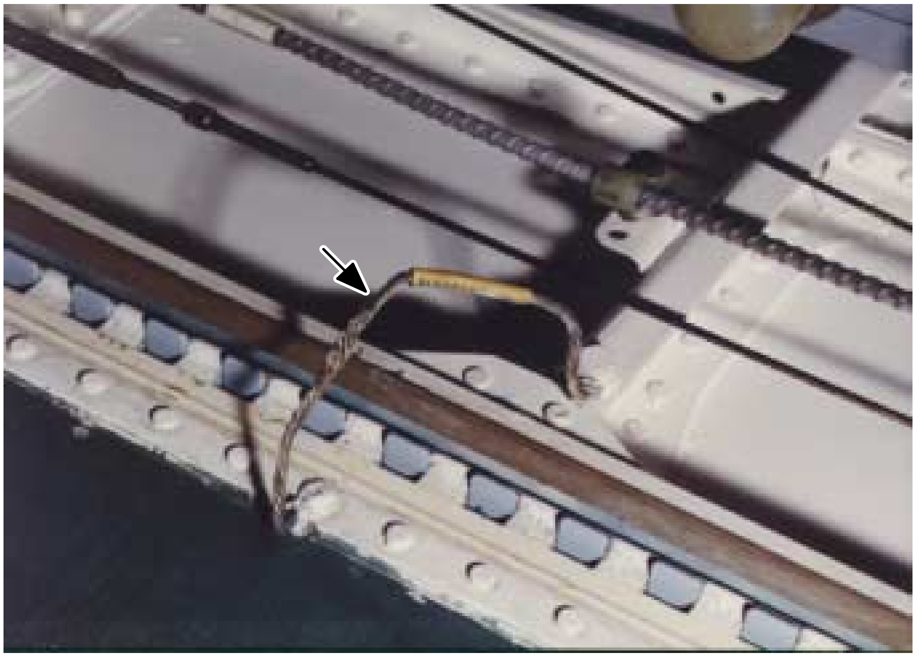


Figure 8-4. Bonding Cable From Airframe to Graphite/Epoxy Avionics Bay Door

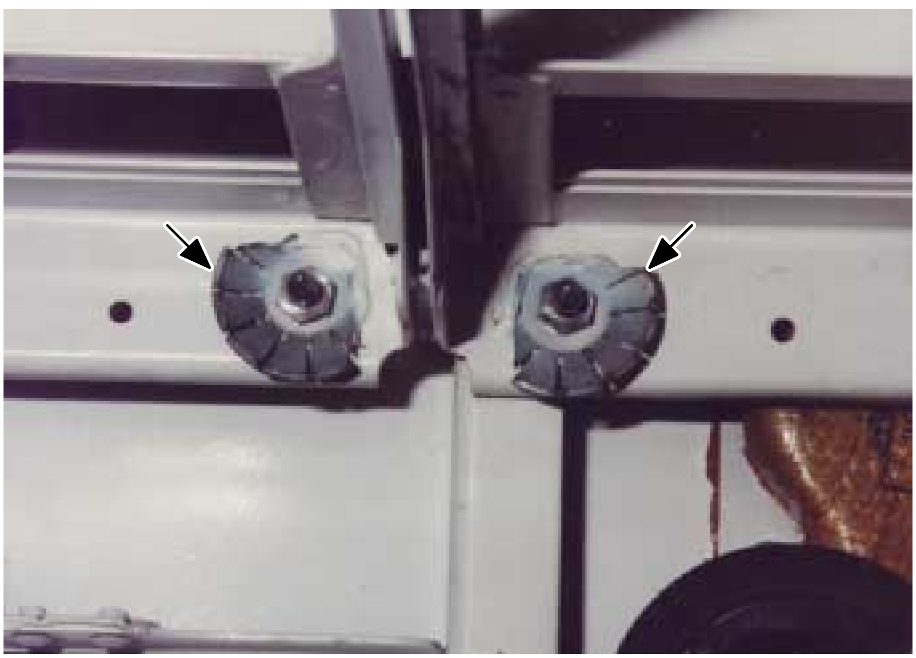


Figure 8-5. EMI Bonding Washers in Avionics Bay

CHAPTER 9

EMERGENCY PROCEDURES

9-1. PURPOSE. This chapter describes the emergency procedures to be followed after aircraft incidents or accidents involving exposure to vast amounts of salt water or fire extinguishing agents. The procedures described herein are used to prevent further damage and will usually require further treatment at a higher level of maintenance.

9-2. RESPONSIBILITY.

CAUTION

Exposure of metal surfaces to salt water, purple K powder (potassium bicarbonate), and protein foam requires immediate action to prevent serious corrosion damage.

NOTE

In cases involving aircraft accidents, permission must be obtained from the senior member of the accident investigation board prior to the initiation of emergency procedures.

The requirement to designate a Corrosion Control Officer who has the responsibility to organize and supervise an emergency reclamation team does not apply to Air Force organizations.

9-2.1. Under emergency conditions, all personnel shall assume responsibility for minimizing damage. Removal of equipment shall be supervised by the Aircraft Maintenance Officer (AMO). Each reporting custodian shall designate a Corrosion Prevention and Control Program Manager to supervise the emergency reclamation team. Maintenance control shall direct the team to accomplish salvage operations or corrosion control action. The size and composition of the team depends on the urgency of the situation and/or workload. If required, additional squadron personnel shall be selected and placed under the direction of the Corrosion Prevention and Control Program Manager. In case of fire damage, the Materials Engineering Division of the Cognizant Field Activity (CFA) must be contacted to determine the effects of heat or excessive salt water contamination prior to continued use or repair of affected parts or components.

9-3. EMERGENCY PREPARATIONS. In preparation of an emergency, priority lists shall be developed for removal of equipment, emergency reclamation planning, and the availability of materials and equipment.

NOTE

Each maintenance officer shall prepare or have access to a list of equipment indicating removal priority.

9-3.1. Priority removal list of aircraft components.

CAUTION

Magnesium parts are particularly susceptible to corrosion attack when exposed to salt water or fire extinguishing materials. Avionic, electrical, and ordnance equipment known to contain magnesium components shall be given high priority for cleaning.

NOTE

Table 9-1 is the suggested priority removal guide for removing and processing equipment which has been exposed to corrosive water or firefighting chemicals. Variations in aircraft designs, configurations, and mission equipment installations may make it necessary to contact custodians of the aircraft to obtain a listing of equipment and the preferred priority of removal and treatment. Priority of removal and treatment should always be oriented toward recovery of salvageable equipment.

9-3.1.1. Table 9-1 is a tabulation of aircraft component groups arranged in order of suggested priority for treatment. Among the factors to be considered when removing equipment are dollar value, corrosion rate, availability of replacement parts, and probability of successful salvage. Whenever manpower or facility shortage prohibits simultaneous processing of all components, treatment shall be given in the order of the priority listing. The table should be considered as a guide, and operations may deviate from the assigned priority when directed by qualified production planning or engineering personnel or the cognizant maintenance officer.

9–3.2. Intermediate emergency reclamation team. The intermediate level emergency reclamation team will provide expertise and facilities for processing equipment received from operational activities. This team shall be responsible for processing equipment received from Organizational/Unit activities. The size of the team, its organization, and the specific equipment requirements will be geared to the needs of the units supported. Recommended equipment includes wash/rinse facilities, drying ovens, dip tanks (for water displacing compounds and preservatives), and cleaning compounds.

9–3.3. Emergency reclamation equipment. The availability of the necessary tools, materials, and equipment for the prompt removal, cleaning, and drying of avionic and electrical equipment will significantly aid in reducing damage. Refer to material and equipment lists (see Table 9–2) and NA 16–1–540. Certain items of equipment which will be useful are:

a. Drying ovens

b. Portable air blowers

c. Heaters

d. Dehumidifiers

e. Backpack pumps

f. Vacuum cleaners

g. Hoses and washing equipment

9–3.4. Production planning. Whenever possible, all salvageable components of the aircraft shall be treated simultaneously. To minimize damage and ensure that the work is accomplished in a thorough and competent manner, the most experienced personnel available shall be assigned to disassemble and process the aircraft. Whenever possible, examination and evaluation personnel shall be assigned to work with the disassembly and preservation crew in order that those items obviously beyond reclamation may be scrapped immediately; and that only those areas exposed to corrosive water or fire fighting chemicals are disassembled and treated. The time saved by this procedure may be utilized in preserving salvageable components.

9–4. GENERAL PROCEDURES.

WARNING

Before starting emergency treatment, particularly in those instances where fuel cells have been ruptured and fuel or fuel vapors are present, it is imperative that a GFE, GFET, or the safety officer supervise purging or inerting procedures and certify that the aircraft is fire and explosion safe. Qualified ordnance personnel shall be assigned to handle all ordnance and associated items, such as ammunition and pyrotechnics.

9–4.1. For cases involving aircraft accidents, permission for any treatment shall be obtained from the senior member of the accident investigation board prior to initiating procedures for emergency reclamation. Failure to obtain permission will jeopardize the ability of the accident investigation team to determine the cause of the incident.

NOTE

Procedures for decontamination of aircraft exposed to chemical, biological, or radiological (CBR) materials are contained in FM 3–5 (Army), T.O. 00–110A–1 (Air Force), or A1–NBCDR–OPM–000 (Navy).

a. Determine from the fire department which extinguishing agent was used on the equipment. A review of photographs taken by public affairs or other media personnel may provide information concerning areas that had corrosive extinguishing material exposure.

b. Ensure that the aircraft is safe for maintenance. Electrically ground the aircraft. Attach the ground lead to the aircraft at a point outside the area which could contain explosive vapors. Turn off all electrical power and disarm aircraft, including the ejection seat.

Table 9-1. Suggested Priority Removal Guide for Emergency Treatment of Aircraft

Priority Number	Reciprocating Engine	Gas Turbine Engine	Turboprop, Turboshaft Engine	Helicopters
1	Engine, propeller, and accessories	Engine and accessories	Propeller drive gear mechanisms	Rotor dynamic components
2	Avionic and fire control equipment	Avionic and fire control equipment	Engine, propeller, and accessories	Engine, rotors, and accessories
3	Instruments	Instruments	Avionic and fire control equipment	Avionic and fire control equipment
4	Fuselage, wings, and empennage	Fuselage, wings, and empennage	Instruments	Instruments
5	Turrets and rocket and missile launchers	Turrets and rocket and missile launchers	Fuselage, wings, and empennage	Fuselage
6	Drained fuel and oil systems	Drained fuel and oil systems	Turrets and rocket and missile launchers	Drained fuel and oil systems
7	Photographic equipment	Photographic equipment	Drained fuel and oil systems	Photographic equipment
8	Landing and arresting gear	Landing and arresting gear	Photographic equipment	Landing gear or floats
9	Safety and survival equipment	Safety and survival equipment	Landing and arresting gear	Safety and survival equipment
10	Electrical equipment	Electrical equipment	Safety and survival equipment	Electrical equipment
11	Armament equipment	Armament equipment	Electrical equipment	Armament and rescue equipment
12	Fixed equipment (seats, etc.)	Fixed equipment (seats, etc.)	Armament equipment	Fixed equipment (seats, etc.)
13	Miscellaneous equipment	Miscellaneous equipment	Fixed equipment (seats, etc.)	Miscellaneous equipment

Table 9–2. Suggested List of Emergency Reclamation Items

Item Number	Accessories	Order Info.	Specification/ Part Number
1.	Aircraft Grounding Straps	--	--
2.	Water/Crash/Fire Damage Tags	App. A, #123	NAVAIR 3750/1
3.	Water/Crash/Fire Damage Labels	App. A, #124	NAVAIR 4035/13
4.	Aircraft Washing Kits	App. B, #1	P/N: 251M
5.	Cleaning & Scouring Pads, Non–metallic	App. A, #36	A–A–3100
6.	Soft Bristle Scrub Brushes	App. B, #3	A–A–2074
7.	Backpack Pump (5–gallon)	App. B, #10	P/N: 5100–254B
8.	Spray Gun, Pneumatic	App. B, #11	MIL–G–952, Type I
9.	Drying Rags	App. A, #40	A–A–50129
10.	Leather Chamois	App. A, #37	KK–C–300
11.	Cleaning Sponges	App. A, #35	A–A–2073
12.	Air Nozzle Gun	App. B, #31	A–A–55543
13.	Air Hose Assembly	App. B, #32	Z–H–500/Z–H–521
14.	Vacuum Cleaner, Pneumatic (Wet/Dry Vac)	App. B, #18	--
15.	Utility Pails, Rubber	App. B, #21	L–P–65
16.	Large Trash Cans & Plastic Liners	--	--
17.	Water Nozzle	App. B, #8	A–A–50461
18.	Water Hose	App. B, #9	A–A–59270
19.	Goggles, Chemical Resistance	App. B, #118	A–A–1110
20.	Face Shield, Industrial	App. B, #116	ANSI Z87.1
21.	Rubber Apron	App. B, #115	A–A–3104
22.	Rubber Gloves, Industrial	App. B, #101	MIL–G–12223
23.	Leather Palm Gloves (for handling composite materials, medium size only)	NSN: 8415–00–268–8350	A–A–50016
24.	Barrier Material	App. A, #88	MIL–PRF–131, Class 1
25.	Aircraft Preservation Tape	App. A, #92	AMS–T–22085, Type II
26.	Full Facepiece Respirator & Cartridges	App. B, #83, #84, & #86	--

Table 9-2. Suggested List of Emergency Reclamation Items (Cont.)

Item Number	Accessories	Order Info.	Specification/ Part Number
27.	Disposal Coveralls, “Bunny Suit”	App. B, #107	A-A-55196, Type I
28.	Heater Gun, Electric	App. B, #16	A-A-59435
	CONSUMABLE MATERIALS		
29.	Corrosion Preventive Compound, Water Displacing (5-gal min.)	App. A, #44	MIL-C-81309, Types II & III
30.	Aircraft Cleaning Compound	App. A, #21	MIL-PRF-85570, Type II
31.	Engine Gas Path Cleaner	App. A, #22	MIL-PRF-85704, Type II RTU
32.	Dry Cleaning Solvent	App. A, #114	A-A-59601, Type II
33.	Isopropyl Alcohol (IPA)	App. A, #119	TT-I-735
34.	Fire Extinguishing Agent (AFFF)	App. A, #60	MIL-F-24385

c. When possible, closely inspect the equipment to determine areas affected. Traces of foam type extinguishing agents may not be present; however, moist residues often indicate previous foam application. Dry powders may be present in joints, faying surfaces, etc., so a careful examination will be necessary.

d. Wherever possible, remove components from affected areas. Open, loosen, or remove covers, access plates, inspection doors, etc. Allow accumulated salt water to drain off wherever possible. If dry chemical fire extinguishing materials have been used, refer to paragraph 9-5.5.

e. Remove gross amounts of contaminants by flushing with fresh water and draining.

f. Remove components and process in accordance with paragraphs 9-4.2 and 9-4.3.

g. Clean the aircraft in accordance with paragraph 9-4.4.

h. Inspect the aircraft and determine whether it can return to flight status following local maintenance action or whether additional maintenance will be necessary.

9-4.2. Removal of contaminated equipment. After salt water immersion, salt water entry, or exposure to any corrosive agents, equipment must be cleaned promptly and thoroughly. Follow the procedures in this chapter for decontaminating specific areas and equipment. Refer to Table 9-1 for assigning priority to equipment removal and treatment.

9-4.3. Removal of components.

9-4.3.1. The mechanical cutting of fuel, hydraulic and oil lines, and electrical leads, and other drastic operations necessary to expedite removal of components are left to the discretion of the AMO directing the operations.

9-4.3.2. When aircraft are involved in water crashes, it shall be assumed that all components, including hollow structural and mechanical members, are contaminated internally. All components shall be disassembled and treated or forwarded to the next highest level of maintenance for disassembly and treatment as required. It shall be established that contaminants have been removed and that all corroded surfaces have been effectively inhibited against further attack prior to returning to operational status.

9-4.4. Clean. Equipment and components shall be cleaned by the team, in accordance with paragraphs 9-5, 9–6, and 9–7, and then delivered to the designated shops for further inspection and maintenance. Equipment that cannot be removed shall be cleaned in place and inspected.

NOTE

All equipment subject to emergency reclamation team procedures must be certified operationally ready before returning to serviceable status. Inspect equipment for corrosion, cracks and heat damage. Obtain the maximum available engineering assistance to determine evaluation of damage. Particular attention shall be given to dissimilar metal joints. Avionic electrical equipment will most likely contain dissimilar metals.

9–4.5. Tagging. All parts and components removed from the aircraft shall be tagged for identification (see Appendix A for Water/Crash/Fire Tags and Labels). Indicate preservation method (CPC) used on component.

9–5. GENERAL CLEANING PROCEDURES.

WARNING

Prolonged breathing of vapors from organic solvents or materials containing organic solvents is dangerous. Prolonged skin contact with many organic solvents or solvent containing materials can have toxic effect on exposed skin areas. Observe precautions listed in previous chapters (or references) for cleaning compounds, solvents, surface treatments, chemicals, sealants, and paints.

CAUTION

Do not expose plastic items, avionic components, wiring, or other components susceptible to heat damage to temperatures in excess of 130_F (54_C) during emergency cleaning procedures. Also, do not expose any other areas to temperatures in excess of 150_F (66_C) during emergency cleaning procedures.

NOTE

The mildest cleaning cycle which will assure proper decontamination shall be used at all times. Even though fresh water/detergent wash should not significantly affect accident investigations, permission must be obtained from the senior member of appointed accident investigation board before performing this operation.

9–5.1. Use the specified methods in paragraphs 9–6 and 9–7 for emergency treatment of specific components. Do not use the following general methods when specific methods are available.

9–5.2. Contaminated areas may be cleaned by several methods. The primary method is fresh water flushing. Alternate methods may be used when fresh water is not available.

9–5.3. Primary Method. The primary method of removing salt water is as follows:

a. Immerse removed unit or component in clean, fresh water whenever possible.

b. Flush all areas with clean fresh water and allow to drain.

c. Dry the item or areas by vacuum cleaning excess water, blotting with cloth or paper, or blow drying with air pressure not greater than 10 psi. If visual evidence of salt remains, a second cleaning should be accomplished as follows:

(1) Mix a solution of one part aircraft cleaning compound (MIL–PRF–85570, Type II) in nine parts water.

(2) Apply the solution to the affected areas and scrub with soft bristle brushes, sponges or cloths.

(3) Flush thoroughly with clean fresh water and drain thoroughly.

(4) Dry the item or areas as before.

d. After flushing and drying, apply water displacing preservative (MIL–C–81309, Type III) on all avionic components and connectors. Ensure that all areas and crevices are coated. Liberally apply water displacing CPC (MIL-C-81309, Type II) to all other areas that cannot be properly drained or contain recesses which are difficult to reach. Ensure that all surfaces are coated.

NOTE

Water displacing CPC (MIL-C-81309, Type II) will deposit a thin, nonconductive film which must be removed for proper function of contact points and other electromechanical devices where no slipping or wiping action is involved. Water displacing CPC is easily removed with dry cleaning solvent (MIL-PRF-680, Type II). Removal will be accomplished during subsequent maintenance or functional test prior to issue for use.

9-5.4. Alternate methods. Use only when fresh water is not available or is available only in limited supply or when time prevents immediate flushing with fresh water.

9-5.4.1. Method one (preferred). Spray, brush, or wipe the exterior of the affected areas and components with liberal amounts of water displacing preservative (MIL-C-81309, Type II).

9-5.4.2. Method two (alternate).

a. Apply a solution of one part aircraft cleaning compound (MIL-PRF-85570, Type II) in nine parts water.

b. Brush over affected areas until contaminants and cleaner become intermixed or emulsified.

c. Wipe off thoroughly with clean cloth, removing both contaminants and cleaner.

d. Liberally apply water displacing CPC (MIL-C-81309, Type II) to affected areas.

9-5.5. Removing Purple K Powder (O-D-1407, potassium bicarbonate) or other dry chemical fire extinguishing agents. To remove powder, proceed as follows:

a. If the surplus can be removed by vacuum cleaning, do so; otherwise, use the following rinse procedure.

b. Use a soft bristle brush and air pressure not greater than 10 psi to dislodge contaminants between close-fitting components.

c. Vacuum clean again.

d. Remove the residual film of dry powder adhering to the surface by wiping, brushing, or spraying with a solution of one part aircraft cleaning compound (MIL-PRF-85570, Type II) in nine parts of water.

e. Rinse thoroughly with fresh water.

f. Dry with cloths or paper towels, or blow dry with air pressure not greater than 10 psi.

g. Liberally apply water displacing CPC (MIL-C-81309, Type II) to affected areas.

h. Enter where and how the affected area was treated in the appropriate section of the aircraft logbook.

9-5.6. Removing MIL-F-24385, Aqueous Film Forming Foam (AFFF). To remove residues of salt water solutions of AFFF fire extinguishing agent, proceed with steps a. through h. below. To remove residues of fresh water solutions of AFFF, use the same procedure but omit steps b. through d.

NOTE

The following procedure applies to AFFF and salt water mixture normally used aboard ship. AFFF and fresh water mixtures usually do not present a corrosion problem. However, cleanup of residues after a fire is required for corrosion prevention.

Enter information of areas and components that were exposed to AFFF fire extinguishing agent (MIL-F-24385) in the appropriate section of the aircraft logbook, corrosion folder, or other appropriate documents to ensure that they are inspected in the future as corrosion prone areas.

a. Flush all affected areas with fresh, clean water while draining. Whenever possible, units or components which have been removed should be immersed in fresh water and then flushed thoroughly with fresh, clean water. Drain away the water.

b. Mix a solution of one pint of AFFF fire extinguishing agent (MIL-F-24385) in 10 gallons of fresh water.

c. Apply solution to affected areas using one of the following methods:

(1) Use a foam generator, solvent wash gun, back pack, or other type of spray equipment.

(2) Use aircraft washing kit, sponges, or low lint cloths, or pour solution directly over affected areas if foaming generator is not available.

d. Keep affected areas wet with AFFF solution for 3 to 5 minutes.

e. Clean surfaces with a solution of one part aircraft cleaning compound (MIL-PRF-85570, Type II) in nine parts of water. Scrub affected areas and rinse with clean, fresh water. Drain away excess water.

f. Dry with cloths, paper towels, or air pressure not greater than 10 psi.

g. Apply water displacing CPC (MIL-C-81309, Type III) to all avionic components and electrical connectors. Liberally apply water displacing CPC (MIL-C-81309, Type II) to all other areas that cannot be properly drained or recesses which are difficult to reach.

h. Enter affected areas in the appropriate section of the aircraft logbook.

9-5.7. Removal of Carbon Dioxide (CO_2), HFC-125, or Halon fire extinguishing agents.

NOTE

Carbon dioxide, HFC-125, or Halon fire extinguishing agents will not leave residues. However, smoke, smudges, or other grime from a fire is corrosive and shall be removed from affected items that are to be retained for future use.

9-5.7.1. CO_2, HFC-125 (pentafluoroethane), Halon 1211 (MIL-DTL-38741, bromochlorodifluoromethane) and Halon 1301 (ASTM D 5632, bromotrifluoromethane) evaporate rapidly. Therefore, no cleanup is required unless moisture or high temperature was present at the area of application. However, ventilation should always be provided to remove the vapors. If moisture or high temperature was present, use the following clean-up procedures.

a. After fire has been extinguished, purge area and surface with clean, dry air (dust free, low moisture content, compressed air).

b. Clean surfaces with a solution of one part aircraft cleaning compound (MIL-PRF-85570, Type II) in nine parts of water. Scrub affected areas and rinse with clean, fresh water. Drain away excess water.

c. Dry with cloths, paper towels, or air pressure not greater than 10 psi.

d. Apply water displacing CPC (MIL-C-81309, Type III) to all avionic components and electrical connectors. Liberally apply water displacing CPC (MIL-C-81309, Type II) to all other areas that cannot be properly drained or recesses which are difficult to reach.

e. Enter affected areas in the appropriate section of the aircraft logbook.

9-5.8. Removal of protein foam (e.g. MIL-F-24385) and soda acid. The residues left from the use of these materials can be very corrosive to aircraft and equipment. Remove residues as follows:

a. Thoroughly flush the affected area with fresh water. Ensure that the rinse water is completely flushed from the aircraft or equipment.

b. Clean surfaces with a solution of one part aircraft cleaning compound (MIL-PRF-85570, Type II) in nine parts of water. Scrub affected areas and rinse with clean, fresh water. Drain away excess water.

c. Dry with cloths, paper towels, or air pressure not greater than 10 psi.

d. Apply water displacing CPC (MIL–C–81309, Type III) to all avionic components and electrical connectors. Liberally apply water displacing CPC (MIL–C–81309, Type II) to all other areas that cannot be properly drained or recesses which are difficult to reach.

e. Enter affected areas in the appropriate section of the aircraft logbook.

9–5.9. Treatment after landing on a foamed runway. Materials used to foam runways are corrosive to aircraft. As soon as possible after a landing on a foamed runway, exterior areas, wheel wells, any interior areas exposed, and engines shall be cleaned. Clean the exterior and wheel wells, interior areas, and engines in accordance with Chapter 3.

9–5.10. Treatment after exposure to volcanic ash. The primary concern in removing volcanic ash is the extreme abrasiveness of the ash. It is not a significantly corrosive material. Aircraft which have been exposed to volcanic ash should be cleaned using the following procedures after exposure and before the next aircraft operation or flight:

a. All static ports, fuel vents, engine inlets, air conditioning inlets, etc., should be vacuumed to remove as much ash as possible and then suitably covered to preclude additional ash entry. Special emphasis should be placed on ducting supplying cooling air to avionics equipment.

b. After covering all openings where ash may enter, the exterior of the airframe or equipment should have ash removed initially using vacuum, low pressure air, or by lightly dusting with clean rags. Avoid rubbing since this may damage surfaces due to the abrasiveness of the ash.

c. Wash entire aircraft or equipment using a mild alkaline water solution (MIL–PRF–85570, Type II, in nine parts fresh water) and rinse thoroughly with low pressure water. Ensure that critical parts, such as flap screws, tracks, and exposed hydraulic actuators are adequately cleaned. Again, caution should be taken when washing to avoid rubbing, since ash is even more abrasive when combined with water as a slurry.

d. Wiper blades should be checked to ensure that all contaminants are removed prior to operation.

e. If ash penetration is evident in the aircraft interior, the cockpit, cargo, and other accessible interior areas, it should be thoroughly vacuumed.

f. Check lower aircraft structures for volcanic ash and water entrapment.

g. Clear all drains and air dry structures as much as possible.

h. Uncover all openings which were covered during steps a. and b.

i. After washing, the aircraft must be lubricated in accordance with applicable maintenance instruction manuals.

9–6. SPECIFIC INTERNAL AREAS. The cockpit, ejection seats, avionic and electrical equipment, identification and modification plates, and photographic equipment require specific emergency cleaning procedures.

9–6.1. Cockpit area. Emergency cleaning procedures for the cockpit are as follows:

a. If the interior is undrainable, drill out fasteners at low point. If still undrainable, drill a hole at the low point.

b. Remove avionics equipment, relay boxes, circuit breakers, and switches, and clean as specified in NAVAIR 16–1–540 (Navy), TM 55–1500–343–23 (Army), or T.O. 1–1–689 (Air Force).

c. Clean ejection seats (see paragraph 9–6.2).

d. Turn over equipment to the activity that has the authority and capability to disassemble.

e. Dry equipment that has been cleaned as much as possible with air pressure (less than 10 psi), drying machines, electric fans, or hand fans in a hot room of 150_F (66_C) maximum or in a well ventilated room where the humidity is low.

f. Apply water displacing CPC (MIL–C–81309, Type II) by spraying or brushing onto all areas that cannot be properly drained or contain recesses which are difficult to reach.

9–6.2. Ejection seats.

WARNING

Disarm ejection seat mechanism before cleaning. Ensure that only authorized personnel disarm seats and perform cleaning operations.

9–6.2.1. The following emergency cleaning procedure shall be used for cleaning ejection seats.

a. Remove parachutes, drogue parachutes (where applicable), and seat pans. Return to local work center for cleaning or replacement.

b. Remove ejection seat in accordance with the applicable maintenance manual.

c. Rinse seat thoroughly with fresh water. Continue rinsing while directing water into crevices and close fitting parts until contaminants are removed.

d. Wipe down cartridge activated devices, rockets, and inertia reels with fresh water. Disarm and remove from seats. Cap all gas lines and ports.

e. Remove as much water as possible from equipment with vacuum or low pressure, clean, dry air.

f. Dry excess water deposits with clean cloth or clean paper towels.

g. Apply water displacing CPC (MIL–C–81309, Type II) by either spray or brush application to critical metal surfaces and recess areas which may not be completely dry. Water displacing CPC will protect equipment during necessary inspections and during transfer to repair custodian.

h. Wash all survival gear and pilot safety equipment with fresh water and dry thoroughly. Refer to applicable maintenance requirements for detailed preservation procedures. Lubricate and control corrosion in accordance with maintenance cards.

i. If necessary, send ejection seat to next highest level of maintenance.

j. Aircraft mounted escape system components (mechanically activated CADS) shall be wiped and dried with a clean cloth and fresh water. If internal contamination is suspected, remove and replace. Forward to a Depot Level Maintenance Center for further disassembly, inspection, and repair.

9–6.3. Avionic and electrical equipment.

WARNING

Ensure that all electrical power is disconnected and all systems in the aircraft are deactivated.

9–6.3.1. Effective cleaning ensures that salt water, fire fighting chemicals, and other corrosive agents are completely removed to prevent corrosion damage. Refer to NAVAIR 16–1–540 (Navy), TM 55–1500–343–23 (Army) or T.O. 1–1689 (Air Force) for specific cleaning procedures.

9–6.4. Photographic equipment. The following procedure is applicable for cleaning photographic equipment.

a. Immediately rinse with fresh water, drain, and rinse again.

b. Apply water displacing CPC (MIL–C–81309, Type III).

c. Return to the appropriate photographic technician for prompt servicing.

9–6.5. Graphite or carbon/epoxy composite materials.

WARNING

The inhalation of graphite composite fibers resulting from aircraft fires and/or aircraft material damage may be harmful to personnel. Wear a full facepiece respirator when exposed to these materials, and, in addition, wear close weave cotton gloves when handling these materials.

CAUTION

Aircraft construction utilizing graphite fiber composite materials and metal structure or substructure creates a high potential for establishing galvanic corrosion cells. This can result in corrosion of the metal components if the structure is exposed to an electrolyte medium, such as salt water.

9–6.5.1. The graphite fibers of composite materials may be released into the atmosphere if their epoxy binder burns; this occurs at temperatures in excess of 600_F (316_C). In addition, fibers may be released by an explosion or a high impact crash. Since graphite is very conductive, these fibers can damage unprotected avionic and electrical equipment within several miles of the incident site by settling on and shorting out electrical contacts. The procedures for treating damaged composite materials are listed below. See NAVAIR 00–80R–14 (Navy), T.O. 1–1–690 (Air Force), or TM 55–1500 series (Army) for additional information.

9–6.5.2. Cleanup.

WARNING

Do not put power to or start up aircraft or electronic/electrical equipment which have been exposed to debris until decontamination by vacuuming and/or washing is completed. Failure to observe these procedures may result in electrical short circuits and fires.

NOTE

It is recommended that assistance of industrial hygiene/safety personnel be requested to provide specific information regarding hazards to personnel during cleanup.

9–6.5.2.1 Appropriate ship maneuvering, to direct the smoke and debris away from parked aircraft and the island structure, can materially reduce fiber contamination and reduce the cleanup process. When damaged aircraft have graphite fiber composite surfaces which are broken or burned, the following procedures should be followed.

a. If ventilation inlets are known to be exposed to debris, take immediate action to ensure that the filtration system is properly operating. If the system is not operating properly, shut down the system and provide temporary filtration at outlets leading to compartments with electrical and electronic equipment.

b. Warn adjacent aircraft and ships that the smoke may contain hazardous electrical contaminants.

c. Spray MIL–C–81309, Type II, on damaged composite surfaces. This will prevent the spread of graphite fiber contamination by causing the fibers to stick together to the damaged surface. Cover damaged surfaces securely with plastic and tape.

d. Aircraft, facilities, clothing and equipment that have been exposed to debris from the aircraft fire must be vacuumed and/or washed down prior to reuse or movement into a ship's interior.

e. Decontamination of the immediate area of the aircraft wreckage may require vacuuming, washing, and bagging of composite material fragments. Use a sealed industrial vacuum. Store collected debris in sealed plastic bags for the accident investigation. Dispose of in accordance with applicable regulations when so directed by the investigation team.

f. If wrapping and secure taping of the aircraft wreckage is not possible, transporting the wreckage must be planned. Bypass heavily populated and industrial areas. Aircraft parked along the planned route must have their canopies and access doors closed and engine inlet and exhaust covered. In addition, the doors and windows of surrounding buildings should be closed to minimize the probability of having wind–blown fibers enter areas containing electrical and electronic equipment.

9–6.6. Boron/tungsten composite materials. The extinguishing, containing, and cleaning practices for boron fibers are the same as those for carbon/graphite fibers, as outlined in paragraph 9–6.5.2.

9–7. SPECIFIC EXTERNAL AREAS. The following external aircraft areas require emergency cleaning.

9–7.1. Airframes. The following procedure is applicable for cleaning airframes:

a. Flush all areas with fresh, clean water while draining. Whenever possible, units or components which have been removed should be immersed in fresh water and then flushed thoroughly with clean, fresh water. Drain away the water and dry the areas with cloths, paper towels, or air pressure less than 10 psi.

b. Cleaning shall be initiated using a solution of one part of aircraft cleaner (MIL–PRF–85570, Type II) in nine parts of water. Scrub affected areas with the solution. Flush thoroughly with fresh water and drain away the excess water. Dry with cloths, paper towels, or air pressure less than 10 psi.

c. Liberally apply water displacing CPC (MIL–C–81309, Type II) to all other areas that cannot be properly drained or contain recesses which are difficult to reach, to aid in the removal of water.

d. If the aircraft fuselage, hull, or wings are in a repairable condition, drain holes may be made for draining water by drilling out rivets at the lowest points. All repairable parts shall be collected and returned with the aircraft when shipment is made.

9–7.2. Antennas. Remove the antenna according to instructions in the aircraft maintenance manual. Treat in accordance with NAVAIR 16–1–540 (Navy), TM 55 1500–343–23 (Army), or T.O. 1–1–689 (Air Force). In-place cleaning may be accomplished as follows:

a. Check antenna insulators for damage or cracks.

b. Brush or spray a solution of one part aircraft cleaning compound (MIL–PRF–85570, Type II) in nine parts water onto the affected area.

c. Scrub the area with a small, soft brush or wiping cloth dipped in the above cleaning solution.

d. Rinse with clean, fresh water.

e. Dry the area with a clean, dry cloth.

9–7.3. Reciprocating engines.

a. Determine the extent of contamination.

b. Drain all fluids. Partial disassembly is authorized to accomplish thorough draining. Ensure that pressure systems and cylinders are drained.

c. Thoroughly flush all surfaces and passages with fresh water.

d. Apply dry cleaning solvent (MIL–PRF–680, Type II).

e. Flush all surfaces and passages with either a solution of one part engine gas path cleaning compound (MIL–PRF–85704, Type II) in four parts fresh water or use the ready–to–use form of MIL–PRF–85704, Type II RTU. Both Type II and II RTU are aqueous cleaners without hydrocarbon solvents.

f. Thoroughly rinse all areas with fresh water.

g. Allow to drain thoroughly. Dry using paper towels, cloths, or air pressure less than 10 psi.

h. Liberally apply water displacing CPC (MIL–C–81309, Type II) to all surfaces. This may be accomplished by fill and drain (preferred), flushing, or spraying. Rotate the propeller shaft to coat cylinder walls. Drain excess CPC.

i. Reassemble engine finger tight.

j. Lubricate any pressure lubrication points to completely displace all contaminated lubricant.

k. For shipping, place engine in an approved dehydrated metal container, using twice the normal amount of desiccant.

9–7.4. Turbine engines. Engines which are contaminated with small amounts of sea water entering the intake shall be cleaned using engine gas path cleaner (MIL–PRF–85704) in accordance with Table 3–1. For Air Force, refer to engine specific technical/overhaul manuals. For engines which have been completely submerged in water or sea water, decontaminate as follows:

a. Drain all fluids. Partial disassembly is authorized to accomplish thorough draining.

b. Thoroughly flush all surfaces and passages with fresh water.

c. Flush all surfaces and passages with either a solution of one part turbine engine gas path cleaning compound (MIL–PRF–85704, Type II) in four parts fresh water or use the ready–to–use form of MIL–PRF–85704, Type II RTU. Both Type II and II RTU are aqueous cleaners without hydrocarbon solvents.

d. Thoroughly rinse all areas with fresh water.

e. Drain thoroughly.

f. Liberally apply water displacing CPC (MIL–C–81309, Type II) to all surfaces. This may be accomplished by fill and drain (preferred), flushing, or spraying. Drain excess CPC. Repeat this procedure until all traces of water have been removed.

g. Lubricate any pressure lubrication points to completely displace all contaminated lubricant.

h. For shipping, install in an approved dehydrated metal container, using twice the normal amount of desiccant. Notify the ACC/SPM to arrange special handling as required.

9–7.4.1. Treatment for engines which have ingested fire extinguishing powder (purple K or sodium bicarbonate).

a. With the ignition off/disconnected, vacuum clean all excess, loose material, then crank the engine and rinse thoroughly with water.

b. Flush all surfaces and passages with either a solution of one part engine gas path cleaning compound (MIL–PRF–85704, Type II) in four parts fresh water or use the ready–to–use form of MIL–PRF–85704, Type II RTU. Both Type II and II RTU are aqueous cleaners without hydrocarbon solvents.

c. Drain engine lubricant and refill.

d. At the next inspection, recheck previously contaminated areas and repeat the above procedure, if necessary.

9–7.5. Helicopter transmission, rotor head, and rotor hub. Helicopter transmission, rotor head, and rotor hub cases are often constructed of magnesium. Magnesium parts exposed to salt water or fire fighting chemicals require immediate and thorough decontamination and preservation.

9–7.5.1. External surface contamination. Treat helicopter transmissions, rotor heads, and rotor hubs with external surface contamination as follows:

a. Rinse with fresh water.

b. Wash with a solution of one part aircraft cleaning compound (MIL–PRF–85570, Type II) in nine parts fresh water and rinse thoroughly.

c. Liberally apply water displacing CPC (MIL–C–81309, Type II) to all affected areas.

d. Lubricate all pressure lubrication points to completely displace all contaminated lubricant.

9–7.5.2. Internal surface contamination. If internal surface contamination of helicopter transmission rotor heads and gearboxes is suspected, immediately contact the appropriate ACC/SPM for assistance and decontamination procedures. Treat helicopter transmissions, rotor heads, and rotor hubs having internal contamination as follows:

a. Drain all fluids. Partial disassembly is authorized to accomplish thorough draining. Ensure that pressure systems are drained.

b. Thoroughly flush all surfaces and passages with fresh water.

c. Flush all surfaces and passages with a solution of one part aircraft cleaning compound (MIL-PRF-85570, Type II) in nine parts fresh water.

d. Thoroughly rinse all areas with fresh water.

e. Allow to drain thoroughly.

f. Liberally apply water displacing CPC (MIL-C-81309, Type II) to all surfaces. This may be accomplished by fill and drain (preferred), flushing, or spraying. With the housing full of preservative, rotate the main shaft approximately five revolutions. After the preservative has remained in the housing for 4 hours, drain and replace plugs.

g. Service transmission in accordance with MIM if going back in service or leave as preserved if shipping out.

h. Lubricate all pressure lubrication points to completely displace all contaminated lubricant.

9-7.6. Helicopter main and tail rotor blades. Helicopter blades that have been exposed to an excessive amount of salt water or liquid fire fighting chemicals shall be treated as follows:

NOTE

Some rotor blades have areas commonly known as pockets or blade boxes with very small drain holes. The drain holes may require enlargement, if salt water immersed, to facilitate decontamination of the blade spar. Enlarging drain holes destroys the affected pockets or blade boxes and requires repair at Depot Level before the blade can be reused. Enlargement of pocket access requires authorization from the appropriate ACC/SPM for each blade involved. Where possible, flush with water displacing CPC (MIL-C-81309, Type II). Preserve and package blade properly before sending to the appropriate ACC/SPM for engineering evaluation and necessary repair.

a. Thoroughly flush all contaminated surfaces with fresh water. Pay particular attention to recesses that tend to trap debris such as mud, dirt, or salt deposits.

b. Wash with a solution of one part aircraft cleaning compound (MIL-PRF-85570, Type II) in nine parts fresh water.

c. Rinse thoroughly with fresh water.

d. Dry with cloth, paper towels or air pressure less than 10 psi.

9-7.7. Armament. The following instructions are for initial treatment of armament equipment that has undergone salt water immersion or been subjected to fire extinguishing chemicals.

9-7.7.1. Safety precautions. Before performing any cleaning tasks, make certain that preliminary safety precautions are followed:

a. Ensure that the aircraft is safe for maintenance.

b. Disconnect all electrical power and ensure that all armament switches are in the OFF or SAFE positions.

NOTE

For removal of armament equipment, refer to applicable manual for the respective aircraft.

c. Remove all ordnance from the aircraft and dispose of contaminated ammunition as required.

9-7.7.2. Cleaning procedure. After completion of safety precautions, complete the following steps:

a. Rinse equipment with fresh water.

b. Disassemble as required and wipe away excess grease with clean cloth dampened with dry cleaning solvent (MIL-PRF-680, Type II).

c. Immerse and agitate parts in a solution of one part aircraft cleaning compound (MIL-PRF-85570, Type II) in nine parts of fresh water.

d. Rinse with fresh water to ensure complete removal of contaminants.

e. Wipe away excess water with clean, dry cloth.

f. Blow dry the cleaned equipment as thoroughly as possible with clean, dry, air pressure less than 10 psi.

g. Liberally apply water displacing CPC (MIL-C-81309, Type II).

h. Inspect to determine whether the equipment should be returned to service or forwarded to the nearest higher maintenance activity.

i. Dip or flush coat the cleaned, dried, and reassembled parts in water displacing CPC (MIL-C-81309, Type II). Permit excess preservative to drain off.

j. Wrap gun in barrier material (MIL-PRF-131, Class 1) and forward to nearest higher maintenance activity.

k. If shipment to the next higher level of maintenance is required, preserve and forward the package in accordance with the applicable instructions.

9-7.8. Aircraft fuel systems. For emergency treatment of aircraft fuel systems contaminated with sea water through other than water, crash, or fire damage, refer to NAVAIR 01-1A-35 (Navy), T.O. 1-1-3 (Air Force), or Appendix D, Section IV (Army).

APPENDIX A

CONSUMABLE MATERIALS

A–1. INTRODUCTION.

NOTE

The materials referenced in this appendix are approved for use, but approval should not be misconstrued as an endorsement of any manufacturer's product(s). If an equivalent for an application/procedure is not referenced herein, contact your service representative for approval: Naval Aviation Depot North Island (Code 434), the Air Force Corrosion Program Office, or the U.S. Army Aviation Systems Command.

A–2. Appendix A provides consumable materials used for aircraft cleaning and corrosion control. Nomenclatures, specifications/part numbers, national stock numbers (NSNs), units of issue (U/I), intended use of materials, shelf life code (SLC), and extension of shelf life code are provided. Items are located by function in the following groupings:

Abrasives
Conversion coating materials
Cleaning compounds
Cleaning pads/cloths
Corrosion preventive compounds
Lubricants
Neutralizing agents
Paint removers
Paint thinners
Paints – primers
Paints – topcoats
Protective materials
Sealants and sealant accessories
Solvents
Tags/labels

A–3. The shelf life code and extension data were taken from NAVSUP Publication 4105 dated 1 July 1976 and NMDL (Navy Management Data List) dated 1 October 1979 to aid users in determining required retest or disposal dates for materials retained in work areas.

A–4. Shelf life and its extension data (given in months) are provided for materials that have a shelf life. For Air Force, consult T.O. 00–20K 1 or 42C–1–12 for shelf life program and quality control.

A–5. Consumable materials of a particular specification are provided in various sized containers. If the particular sized container required is not available or listed, ask supply department to provide the next size container under the same specification.

A–6. When local purchase is specified, include all procurement information, source of supply and GSA contract number if available.

A–7. Prior to the procurement/use of any specified products for cleaning, corrosion prevention, touch–up painting, etc., local environmental requirements, i.e., laws, regulations, shall be complied with.

A–8. The units of issue abbreviations are shown and explained as follows:

CODE	UNIT	CODE	UNIT	CODE	UNIT
BG	Bag	DZ	Dozen	OZ	Ounce
BO	Bolt	EA	Each	PG	Package
BT	Bottle	FT	Foot	PR	Pair
BX	Box	GL	Gallon	PT	Pint
CA	Cartridge	GR	Gross	QT	Quart
CB	Carboy	JR	Jar	RO	Roll
CN	Can	KT	Kit	SE	Set
CO	Container	LB	Pound	SH	Sheet
CS	Case	LG	Length	TU	Tube
DR	Drum	MX	Thousand	YD	Yard

Appendix A. Consumable Materials

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
		Abrasives			
1.	Abrasive Mats, Aluminum Oxide, Non-woven, Non-metallic (9” x 11” sheets)	A-A-58054 (supersedes MIL-A-9962) Type I, Class 1 Grade A (Very Fine) Grade B (Fine) Grade C (Medium)	 5350-00-967-5089 5350-00-967-5093 5350-00-967-5092	 PG (10 SH) PG (10 SH) PG (10 SH)	Aluminum oxide impregnated nylon fiber webbing used for removing corrosion products and for paint scuffing prior to touching up and feathering edges.
2.	Abrasive Paper, Aluminum Oxide, Non-waterproof (9” x 11” sheets)	A-A-1048 240 Grit 320 Grit	 5350-00-829-3981 5350-01-075-9299	 PG (50 SH) PG (50 SH)	Dry sanding of light to moderate corrosion products.
3.	Abrasive Paper, Silicon Carbide, Waterproof (9” x 11” sheets)	A-A-1047 (supersedes P-P-101) 240 Grit 320 Grit	 5350-00-224-7205 5350-01-043-2278	 PG (50 SH) PG (50 SH)	Wet or dry sanding of light to moderate corrosion products.
4.	Abrasive Paper, Silicon Carbide, Non-waterproof (9” x 12” sheets)	A-A-1047 (supersedes P-P-101) 240 Grit 320 Grit	 5350-00-224-7208 5350-00-867-7665	 PG (50 SH) PG (50 SH)	Dry sanding of light to moderate corrosion products.
5.	Abrasive Paper Discs, Pressure Sensitive Backing, Silicon Carbide (6” dia.)	A-A-2697 180 Grit 280 Grit	 5345-01-074-9404 5345-01-074-9406	 RO (250 EA) RO (250 EA)	Dry sanding of light to moderate corrosion products. For use with pneumatic drills or orbital sanders with a 6” diameter pad.
6.	Abrasive Cloth, Aluminum Oxide, Waterproof (9” x 11” sheets)	A-A-1048 (supersedes P-C-451) 240 Grit 320 Grit	 5350-00-865-5948 5350-00-597-5798	 PG (25 EA) PG (25 EA)	Wet or dry sanding of light to moderate corrosion products.
7.	Abrasive Cloth, Aluminum Oxide, Non-waterproof	A-A-1048 (supersedes P-C-451) 240 Grit (9” x 11” sheets) 240 Grit (3” x 150’ roll) 320 Grit (9” x 11” sheets) 320 Grit (2” x 150’ roll) 320 Grit (3” x 150’ roll)	 5350-00-161-9715 5350-00-229-3080 5350-00-246-0330 5350-00-187-6289 5350-00-229-3092	 PG (50 EA) RO (50 YD) PG (50 EA) RO (50 YD) RO (50 YD)	Dry sanding of light to moderate corrosion products.
8.	Abrasive Cloth, Silicon Carbide, Non-waterproof (2” x 150’ roll)	A-A-1200 (supersedes P-C-451) 240 Grit 320 Grit	 5350-00-256-5162 5350-00-482-5585	 RO (50 YD) RO (50 YD)	Dry sanding of light to moderate corrosion products.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
9.	Aluminum Wool	A-A-1044 Type II, Class 1 (Medium)	5350-00-286-4851	LB	Removing corrosion from aluminum surfaces.
10.	Copper Wool	A-A-1044 Type I, Class 3 (Fine)	5350-00-255-7736	LB	Removing corrosion from copper alloys, bronze, and brass surfaces.
11.	Steel Wool, Stainless	A-A-1043 Type IV, Class 1 (Rolls)	5350-00-440-5035	LB	Removing corrosion from stainless steel surfaces.
12.	Glass Bead Media, Cleaning and Peening	MIL-G-9954 Size 13	5350-00-576-9634	BG (50 LB)	Glass bead blasting media use for removing corrosion from aluminum surfaces. The equivalent industry specification is AMS 2431/6, size AGB-6.
13.	Plastic Bead Media (20/30 grit in size)	MIL-P-85891 Type V (Acrylic)	5350-01-326-9261 5350-01-326-9262	BG (50 LB) DR (250 LB)	Plastic blasting media use for removing paint from aluminum surfaces. It is not effective at removing corrosion. **NOTE:** Not authorized for use prior to fluorescent penetrant inspection (FPI).
14.	Pumice Abrasive, Powder	SS-P-821	5350-00-161-9033	LB	Removing stains or corrosion on thin metal surfaces.
		Chemical Conversion Coating Materials			
15.	Touch-N-Prep (TNP) Pen	Alodine 1132 t	8030-01-460-0246	CS (12)	The pens provide a clean and easy-to-use method for applying chemical conversion coatings per MIL-C-81706, Class 1A. Ideal for touching-up small surface areas. The treated surface does not require rinsing or wiping off.
16.	Chemical Conversion Coating for Aluminum and its alloys	MIL-C-81706, Class 1A Form III (ready to use premixed liquid)	8030-00-142-9272 8030-00-065-0957 8030-00-823-8039 8030-01-429-9504	PT QT GL DR (55 GL)	Treatment of clean, bare aluminum to impart a protective oxide coating. Class 1A coatings provide maximum protection against corrosion when left unpainted and superior adhesion when paint systems are applied.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
16.	(Cont.)	Form II (powder)	8030–00–926–9131 8030–00–720–9739 8030–00–663–9847	CO (5 LB) CN (12 LB) DR (175 LB)	Powder form has an indefinite shelf life until mixed with deionized (DI) water.
		Form I (concentrated liquid)	8030–01–043–7644	CN (5 GL)	
		MIL–C–81706, Class 3 Form III (ready to use premixed liquid)	8030–01–451–0284	GL	Treatment of clean, bare aluminum to impart a protective oxide coating. Class 3 coatings are intended for use as a corrosion preventive film for electrical and electronic applications where lower resistant contacts are required.
17.	Chemical Conversion Coating for Aluminum and its alloys (non–ferricyanide catalyzed)	MIL–C–81706, Class 1A & 3 Form II (powder)			Non–ferricyanide conversion coating for the treatment of clean, bare aluminum to impart a chromate oxide coating.
		Alodine 600	8030–00–811–3723 8030–01–018–2838	BT (2 LB) CO (10 LB)	
		Turcoat Alumigold	8030–01–341–8609	CB (125 LB)	
18.	Chemical Conversion Coating for Magnesium and its alloys, Brush–on (Dow #19 process)	AMS–M–3171, Type VI (chromic acid brush–on treatment)	8030–00–764–6176	QT	Treatment of clean, bare magnesium to impart a protective oxide coating using a chromium trioxide and calcium sulfate mixture. The instruction for preparing this solution from powder (Chromium Trioxide and Calcium Sulfate) can be found in Chapter 5, Section II of this Manual.
19.	Chromium Trioxide, Technical (Chromic Acid)	A–A–55827	6810–00–264–6517	CN (5 LB)	One of two chemicals used to prepare a magnesium conversion coating solution (AMS–M–3171, Type VI).
20.	Calcium Sulfate, Technical	O–D–210	6810–00–242–4066	CN (1 LB)	One of two chemicals used to prepare a magnesium conversion coating solution (AMS–M–3171, Type VI).

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
		Cleaning Compounds			
21.	Cleaning Compound: Aircraft, Exterior	MIL-PRF-85570			Cleaning of painted and unpainted aircraft surfaces. Check for regulatory compliance before using Type I because it contains aromatic solvents.
		Type I (General purpose, solvent based)	6850-01-237-7482 6850-01-237-8003 6850-01-237-8004	CN (5 GAL) DR (15 GAL) DR (55 GAL)	
		Type II (General purpose, non-solvent based)	6850-01-239-0571 6850-01-235-0872 6850-01-248-9828 6850-01-236-0128	GL (1 GAL) CN (5 GAL) DR (15 GAL) DR (55 GAL)	Cleaning of painted and unpainted aircraft surfaces. Water based formula may be used on both high gloss and camouflage paint systems.
		Type III (Gloss paint cleaner)	6850-01-232-9164	CN (5 GAL)	Abrasive spot cleaner for high gloss paint surfaces where Type II is not effective.
		Type IV (Flat paint cleaner)	6850-01-235-0873 6850-01-248-9829 6850-01-248-9830	CN (5 GAL) DR (15 GAL) DR (55 GAL)	Use on low gloss tactical paint scheme coatings to remove stubborn contaminants such as boot marks and smudges as well as gun blast and exhaust tack soil.
		Type V (Gel-type cleaner)	6850-01-234-0219 6850-01-248-9831 6850-01-235-7458	CN (5 GAL) DR (15 GAL) DR (55 GAL)	Cleaning of wheel wells, wing butts, and other areas where complete rinsing with water can be tolerated. Thixotropic cleaner clings to vertical or overhead surfaces.
22.	Cleaning Compound: Engine Gas Path Cleaner	MIL-PRF-85704			Removal of accumulated salt, dirt, and oily residues from the gas path.
		Type I (Solvent concentrate)	6850-00-181-7594 6850-00-181-7597	CN (5 GL) DR (55 GL)	Solvent conc. for cleaning compressor section of gas engines with the engine off-line (starter cranked).
		Type II (Aqueous concentrate)	6850-01-372-8303 6850-01-372-8304	CN (5 GL) DR (55 GL)	Aqueous conc. for cleaning compressor section of gas engines with the engine off-line (starter cranked).
		Type II RTU (Ready-To-Use aqueous cleaner)	6850-01-370-5245 6850-01-370-5244	CN (5 GL) DR (55 GL)	Ready-to-use aqueous cleaner for cleaning gas engines with the engine off-line (starter cranked).
		Type III (Aqueous concentrate)	6850-01-433-6436 6850-01-433-6438	CN (5 GL) DR (55 GL)	Aqueous conc. for on-line (fired) cleaning of gas engines IAW applicable engine maintenance instructions.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
23.	Cleaning Compound: Parts Washers and Spray Cabinets	AMS–C–29602 (supersedes MIL–C–29602) Type I (Liquid concentrate) Type II (Powder concentrate)	 6850–01–431–2269 6850–01–431–2267 6850–01–431–2268 6850–01–053–2789 6850–01–431–9025 6850–01–431–9024	 GL (1 GAL) CN (5 GAL) DR (55 GAL) LB (1 LB) CO (50 LB) DR (400 LB)	Detergent for use in parts washers and spray cabinets to clean aviation weapons systems, engine, and support equipment components. Removes grease, oil, and dirt present on disassembled components.
24.	Deicing/Anti–Icing Fluid, Aircraft	AMS 1424 (supersedes MIL–A–8243) Type I (Propylene Glycol based)	 6850–01–435–6471 6850–01–435–6468 6850–01–435–6465 6850–01–449–9469	 GL CN (5 GL) DR (55 GL) CO (275 GL Tote)	Fluid is generally used heated, either diluted with water, or as supplied, for the removal of, and for time–limited protection against, deposits of frost, ice, and snow on exterior aircraft surfaces prior to take–off.
25.	Cleaning Compound, Optical Lens (Ready to Use)	A–A–59199 (supersedes MIL–C–43454) Type I (20% alcohol) Type II (57% alcohol)	 6850–00–392–9751 6850–00–227–1887 6850–00–188–9875	 BT (2 OZ) QT QT	Cleaning exposed optical surfaces.
26.	Disinfectant, General Purpose, Phenolic Type, Concentrate	O–D–1435 Liquid Powder (8 oz. pouches)	 6840–00–530–7109 6840–00–753–4797	 BX (4, 1–gal COs) BX (12 EA)	Treatment of relief tube areas.
27.	Detergent: Liquid (Nonionic), General Purpose, Concentrate for Fresh or Sea Water	MIL–D–16791 Type I (Water soluble) Type II (Oil soluble)	 7930–00–282–9699 7930–00–985–6911 7930–00–282–9700 7930–00–531–9715 7930–00–531–9716	 GL (1 GAL) CN (5 GAL) DR (55 GAL) GL (1 GAL) CN (5 GAL)	Type I when dissolved in either fresh water or sea water will remove grease, oil, and dirt from a wide variety of surfaces. Type II when dissolved in kerosene, diesel fuel, high flash coal tar naphtha and similar hydrocarbon solvents will remove grease, oil sludge, some types of corrosion preventative compounds and other similar soils.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
28.	Detergent: External Removable Fuel Tank Cleaner	MIL-D-81956	6850-01-268-1754 6850-01-060-5921	CN (5 GL) DR (55 GL)	Use for removing traces of flammable solvents from aircraft external removable fuel tanks.
29.	Water Repellent: Window and Windshield, Glass and Plastic	MIL-W-6882	6850-00-139-5297	BT (8 OZ)	Anti-wetting film applied to exterior of glass or acrylic plastic windows and windshields to assure good visibility under rain conditions.
30.	Cleaning Compound: Pipe Cleaner	P/N: 840507	9920-00-292-9946	BX (1344 EA)	Cleaning small orifices and crevices.
31.	Metal Polish, Aluminum	A-A-59318 (supersedes MIL-P-6888) Type I (Liquid) Type II (Paste)	 7930-00-266-7131 7930-00-267-1224 7930-00-734-4010	 QT GL QT	Polishing unpainted aluminum aircraft surfaces. The abrasive quality of the polish enables it to remove tarnish and produce a high lasting shine. The polish shall not be used on aluminum aircraft surfaces that are to be painted.
32.	Plastic Polish	P-P-560 Type I (Liquid)	 7930-00-634-5340 7930-00-935-3794	 PT BX (24 EA)	Cleaning and polishing of plastic materials to remove light scratches, and surface prep for application of an anti-static film which will prevent the electrostatic attraction of dust, lint, ash, etc. to the acrylic plastic.
33.	Erasers, Rubber	A-A-132 (supersedes ZZ-E-661) Rectangular with beveled ends	 7510-00-949-5055	 DZ (12 EA)	Removal of light tarnish or corrosion from electrical connectors and avionics components.
			Cleaning Pads/Cloths		
34.	Face Respirator Cleaning Wipe (towelettes)	3M No. 504	Open Purchase	CS (500)	Hygienic cleaning of respirators and other personal protective gear/equipment (alcohol-free formula).
35.	Sponge, Aircraft Cleaning (synthetic plastic)	A-A-2073 (supersedes L-S-626) Type I, Style B Small Large	 7920-00-633-9908 7920-00-633-9915	 EA EA	Absorbent sponge for washing and straining.
36.	Cleaning and Scouring Pad, Non-metallic (for aircraft)	A-A-3100 (supersedes MIL-C-83957) Type I (3/8” thick) Type II (1” thick)	 7920-00-151-6120 7920-00-171-1534	 PG (10 SH) PG (10 SH)	Non-woven, non-metallic, non-abrasive, polyester cleaning and polishing pads (12”L x 6”W) for use on aluminum aircraft surfaces. Replacement pads for aircraft wash kit (Appendix B, Item No. 1)

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
37.	Leather Chamois (Natural in color)	KK–C–300 Grade B, Class 2	8330–00–823–7545	PG (5)	Absorbent towel for washing, polishing, and straining water and other impurities.
38.	Cheesecloth (100% Cotton)	A–A–1491 (supersedes CCC–C–440)			Cleaning and polishing surfaces, and for straining paint.
		Type I (Grade No. 90)	8305–00–262–3321	BO (36"x 50 YD)	
		Type II (Grade No. 50)	8305–00–205–3495 8305–00–205–3496	BO (36"x 100 YD) PG (36"x 10 YD)	
		Type III (Grade No. 10)	8305–01–125–0725	PG (36"x 5 YD)	
39.	Cloth: Non–woven Wiping Cloths	A–A–162 (supersedes CCC–C–46)			
		Type I (Untreated) Class 1 (Light duty) Class 2 (Heavy duty)	 7920–00–292–9204 7920–00–401–8034	 MX (1000 EA) HD (100 EA)	General cleaning applications (e.g. wiping up grease and liquid spills).
		Type II (Treated)	7920–00–782–3779	HD (100 CS)	Treated with oil for soil pick–up (not for use with water).
40.	Cloth: Flannel, Cotton	A–A–50129 (supersedes CCC–C–458)	8305–00–913–5817	BO (50 YD)	Cleaning and polishing of plastic surfaces such as canopies, windscreens, etc.
41.	Cloth: Cleaning, Low–Lint (White in color)	A–A–59323 (supersedes MIL–C–85043)			Cleaning of hydraulic clean room and fluid systems.
		Type I (Clean room use)	7920–00–165–7195	BX (10 LB)	Do not use these cloths with flammable solvents; such use may result in a fire.
		Type II (General use)	7920–00–044–9281	BX (10 LB)	
		Corrosion Preventive Compounds			
42.	Corrosion Preventive Compound, Solvent Cutback, Cold Application	MIL–PRF–16173 Class II, Grade 1 (Hard Film)	 8030–01–396–5731 8030–01–396–5732 8030–01–347–0970 8030–01–396–5237	 PT GL (1 GAL) CN (5 GAL) DR (55 GAL)	Long term protection of metal surfaces against corrosion with or without coverings (indoors or outdoors).

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
42.	(Cont.)	Class I, Grade 2 (Soft film)	8030-00-118-0666 8030-01-149-1731 8030-00-244-1297 8030-00-244-1298 8030-00-244-1295	CN (11 OZ Aerosol) QT GL (1 GAL) CN (5 GAL) DR (55 GAL)	Thick, grease-like consistency for protecting metal surfaces against corrosion during rework or storage. Includes extended indoor protection of interior or exterior surfaces without the use of barrier materials. For outdoor protection, this material can only be used for a limited time where temperature is not extreme.
		Class II, Grade 4 (Transparent, non-tacky soft film)	8030-01-396-5738 8030-01-396-5743 8030-01-347-0972 8030-01-396-5736	PT GL (1 GAL) CN (5 GAL) DR (55 GAL)	Thin, transparent, tack-free protective film for protection of metal surfaces against corrosion during indoor storage and limited outdoor preservation. Use on control cables, fasteners, bare metal areas, or anywhere temporary (30 days or less) protection is needed.
43.	Corrosion Preventive Compound, Water Displacing, Clear (AMLGUARD)	MIL-C-85054 Type I (Pressurized container)	 8030-01-066-3971 8030-01-041-1596	 CN (12 OZ Aerosol) CN (16 OZ Aerosol)	Temporary repair of small paint damage areas from chips, scratches, or cracks. Intended for use on non-moving parts not requiring a lubricated surface, such as fasteners, seams, access panels, joints, unpainted metal, etc.
		Type II (Bulk form)	8030-01-347-0983 8030-01-347-0981 8030-01-347-0982	BT (32 OZ Sprayer) QT CN (5 GAL)	
44.	Corrosion Preventive Compound, Water Displacing, Ultra-Thin Film	MIL-C-81309 Type II (Soft film) Class 1 (Non-pressurized)	 8030-00-213-3279 8030-00-262-7358 8030-00-524-9487	 GL (1 GAL) CN (5 GAL) DR (55 GAL)	Water displacing CPC which may be applied by dipping, spraying, brushing or from pressurized containers. Suitable for use on any metal surface for indoor and short term outdoor protection where surfaces can be re-coated when required. **NOTE:** It should not be used around liquid oxygen fittings.
		Class 2 (Pressurized container)	8030-00-938-1947	CN (16 OZ Aerosol)	
		Type III (Soft film, avionic grade) Class 1 (Non-pressurized) Class 2 (Pressurized container)	 8030-01-347-0978 8030-00-546-8637	 GL (1 GAL) CN (16 OZ Aerosol)	Water displacing CPC for use on avionic equipment, electrical connector plugs, and contact points.
45.	Lubricating Oil, General Purpose, Preservative (Water Displacing, Low Temperature)	VV-L-800	9150-00-273-2389 9150-00-458-0075 9150-01-374-2021 9150-00-231-6689 9150-00-231-9045 9150-00-231-9062 9150-00-281-2060	CN (4 OZ) CN (16 OZ Aerosol) PT (16 OZ Sprayer) QT GL (1 GAL) CN (5 GAL) DR (55 GAL)	The oil can be applied by dipping, brushing, or spraying for lubricating and short term protection of parts against corrosion.

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
46.	Lubricant, Cleaner, and Preservative for Weapons and Weapons Systems (CLP)	MIL–L–63460	9150–01–079–6124 9150–01–054–6453 9150–01–327–9631 9150–01–053–6688	BT (4 OZ Squeeze) PT (16 OZ Sprayer) QT (32 OZ Sprayer) GL (1 GAL)	Lubrication and short term preservation of aircraft hinges, and small and large caliber weapons. **NOTE:** Do not use MIL–L–63460 on rubber or other elastomeric materials. Use only in areas from which solvents can evaporate. Do not use as a direct substitute for VV–L–800.
47.	Corrosion Preventive Compound, Petroleum, Hot Application	MIL–C–11796			Preservation of interior surfaces of structural aluminum alloy tubing assemblies.
		Class 1 (Hard film compound)	8030–00–231–2354 8030–00–597–3288 8030–00–231–2352	CN (5 LB) CN (35 LB) DR (400 LB)	
		Class 1A (Hard film, non–slick)	8030–00–823–8054 8030–00–514–1843	CN (35 LB) DR (400 LB)	
		Class 3 (Soft film compound)	8030–00–598–5915 8030–00–231–2353 8030–00–285–1570	PT CN (5 LB) CN (35 LB)	
48.	Linseed Oil, Boiled	ASTM D260 (supersedes A–A–371)	8010–00–244–8961 8010–00–814–3057 8010–00–152–3245 8010–00–684–8789 8010–00–242–6114	PT QT GL CN (5 GAL) DR (55 GAL)	Preservation of interior surfaces of structural carbon steel tubing assemblies.
			Lubricants		
49.	Grease: Aircraft, General Purpose, Wide Temperature Range (–65_F to 350_F)	MIL–PRF–81322			
		Grade 1	9150–01–378–0744 9150–01–378–0559 9150–01–378–0693	TU (8 OZ) CN (1.75 LB) CN (6.5 LB)	Lubricating aircraft arresting gear sheave spacers and other equipment that operate under high contact loads and high sliding speeds.
		Grade 2	9150–00–181–7724 9150–01–262–3358 9150–00–944–8953	TU (8 OZ) CA (14 OZ) CN (1.75 LB)	Lubricating aircraft wheel bearings and internal brake wheel assemblies, anti–friction bearings, gearboxes, and plain bearings.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
50.	Grease: Aircraft and Instrument, Gear and Actuator Screw, Low Temperature Range (-100_F to 250_F)	MIL-PRF-23827	9150-00-985-7244 9150-00-985-7245 9150-00-935-4017 9150-00-985-7246 9150-00-985-7247 9150-00-985-7248	TU (4 OZ) TU (8 OZ) CA (14 OZ) CN (1.75 LB) CN (6.5 LB) CN (35 LB)	Lubricant and gelling agent for use in ball, roller and needle bearings, gears and on sliding and rolling surfaces of such equipment as instruments, cameras, electronic gear and aircraft control systems that are subject to extreme marine and low temperature conditions. It can be used for rolling and sliding surfaces of equipment having low motivating power (low torque equipment). Also intended for general use on aircraft gears, actuator screws, and other equipment requiring a lubricant with high load carrying capacity.
51.	Grease: Plug Valve, Gasoline, Oil, and Water Resistant	AMS-G-6032 (formerly MIL-G-6032) Type I (Bulk) Type II (Cylindrical sticks) Class A (1/4”D x 7/8”L) Class B (13/32”D x 1-3/8”L) Class C (35/64”D x 2”L) Class D (21/32”D x 2-7/16”L) Class G (55/64”D x 3-3/8”L)	 9150-00-190-0926 9150-00-257-5360 9150-00-261-8287 9150-00-261-8289 9150-00-261-8290 9150-00-261-8291 9150-00-261-8292	 CN (8 OZ) CN (1.75 LB) BX (24 EA) BX (24 EA) BX (24 EA) BX (24 EA) BX (24 EA)	Lubrication of tapered plug valves. The two types provide for the use in high pressure lubrication equipment or for servicing those valves which require a stick type lubricant. Also may be used as a gasket lubricant or seal and for general plug valve service in systems where gasoline, oil, alcohol, or water resistance is required.
52.	Grease: Aircraft and Instrument, Fuel and Oxidizer Resistant	MIL-PRF-27617 Type I (-65_F to 300_F) Type III (-30_F to 400_F)	 9150-01-007-4384 9150-01-311-9771 9150-00-961-8995 9150-01-358-5154	 TU (8 OZ) CN (1.75 LB) TU (8 OZ) CN (1 LB)	Lubrication of taper plug valves, gaskets, and bearings in fuel systems of aircraft and ground support equipment. Also suitable for use in liquid oxygen systems as as a lubricant for valves, threads, and bearings in aerospace vehicles and supporting equipment. May not be suitable for aluminum and magnesium dynamic bearing lubrication because of possible ignition hazards. Type III is more commonly known as “Krytox,” and is liquid oxygen (LOX) compatible.
53.	Grease: Molybdenum Disulfide, Low and High Temperatures, Oxidation and Water Resistant (-100_F to 250_F)	MIL-G-21164	9150-00-935-4018 9150-00-754-2595 9150-00-223-4004 9150-00-965-2003 9150-01-219-1629	CA (14 OZ) CN (1.75 LB) CN (6.5 LB) CN (35 LB) DR (44 LB)	Lubricant for accessory splines, heavy loaded sliding steel surfaces, or for anti-friction bearings carrying high loads and operating through wide temperature ranges where molybdenum disulfide will prevent or delay seizure in the event of inadequate lubrication. Should not be used for wheel bearings or for other than steel surfaces without authorization.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
54.	Grease: Pneumatic System, for Cutting, Lubricating, and Hydraulic	AMS-G-4343 (formerly MIL-G-4343)	9150-00-119-9291 9150-00-269-8255	TU (2 OZ) CN (1.75 LB)	Lubricant between rubber and metal parts of pneumatic systems. It may also be used for pressurized cabin bulkhead grommets and other mechanisms requiring rubber to metal lubrication.
55.	Grease: Aircraft, Helicopter Oscillating Bearing (-65_F to 160_F)	MIL-G-25537	9150-00-478-0055 9150-00-616-9020 9150-00-721-8570 9150-00-721-8581	CA (14 OZ) CN (1.75 LB) CN (6.5 LB) CN (35 LB)	Lubrication of bearings having oscillatory motion of small amplitude.
56.	Grease: Aircraft, Ball and Roller Bearing (-100_F to 450_F)	MIL-G-25013	9150-00-823-8048 9150-00-935-4019 9150-01-234-5866 9150-00-141-6770 9150-00-141-6771	TU (8 OZ) CA (14 OZ) CN (1 LB) CN (1.75 LB) CN (35 LB)	Ball and roller bearing lubrication. It may be used on aircraft actuators, gear boxes, and similar equipment where authorized by applicable maintenance manual.
57.	Lubricant: Molybdenum Disulfide and Silicone Oil based	DOD-L-25681	9150-00-543-7220	LB (1 LB)	Lubricant for use on slow-speed sliding surfaces subject to high temperatures in aircraft gas turbine engines and as an antiseize compound on threaded parts.
58.	Lubricant: Solid Film, Heat-Cured, Corrosion Inhibiting	MIL-L-46010 Type I Type II Type III Color 1 (Natural) Color 2 (Black)	 9150-00-834-5608 9150-00-985-7255 9150-00-948-6912 9150-00-948-7025 9150-01-416-9506 9150-01-416-9509	 PT GL QT GL GL GL	Lubricant for use to reduce wear and prevent galling, corrosion, and seizure of metals. Ideal for sliding motion applications such as plain and spherical bearings, flap tracks, hinges, thread, and cam surfaces. It is also useful where a solvent-resistance coating is required, and where long-term corrosion protection is needed under static conditions. Before using Type III in lieu of Types I and II, engineering authorization is needed.
59.	Lubricant: Solid Film, Air-Cured, Corrosion Inhibiting	MIL-L-23398 Type I (Bulk) Type II (Aerosol)	 9150-00-954-7422 9150-00-754-0064 9150-01-260-2534	 CN (1 QT) CN (12 OZ Aerosol) CN (16 OZ Aerosol)	Lubricant can be applied by dipping, brushing, or spraying for use on steel, titanium, or aluminum bearing surfaces where moderate wear life and corrosion protection is desired. It is suitable for sliding motion applications such as in plain spherical bearings, flap tracks, hinges and cam surfaces, especially where it is not feasible to use the type of solid film lubricant which requires baking at an elevated temperature.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
			Neutralizing Agents		
60.	Fire Extinguishing Agent, Aqueous Film Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater	MIL-F-24385 Type 3 (Green) Type 6 (Blue)	 4210-01-139-4972 4210-01-144-0291 4210-01-056-8343 4210-01-056-0883	 CN (5 GAL) DR (55 GAL) CN (5 GAL) DR (55 GAL)	Concentrate for mechanical foam generating equipment such as fire-fighting trucks or foam sprinkler systems for extinguishing fires. Dilute and use the AFFF agent with fresh or sea water in the following proportion to achieve optimum performance: 3 part Type 3 conc. to 97 part water and 6 part Type 6 conc. to 94 part water. Current shipboard equipment requires Type 6.
61.	Ammonium Hydroxide, Technical (Aqua Ammonia)	O-A-451 Type I (30% by wt.)	 6810-00-584-3793 6810-00-817-9929	 PT GL	Neutralizing agent for acids in urine.
62.	Sodium Bicarbonate, Technical (Baking Soda)	ASTM D928 (supersedes A-A-374)	6810-00-264-6618 6810-00-297-0092	BX (1 LB) BG (50 LB)	Neutralizing sulfuric acid electrolyte deposits from lead acid batteries.
63.	Vinegar, White, Distilled	Z-V-401	8950-00-307-5585 8950-01-451-4135	GL CS (6, 1-GAL)	Neutralizing potassium hydroxide electrolyte deposits from nickel-cadmium batteries.
64.	Sodium Phosphate, Monobasic, Anhydrous, Technical	ANSI/AWWA B504 (supersedes MIL-S-13727)	6810-00-281-1858	BG (100 LB)	Neutralizing potassium hydroxide electrolyte deposits from nickel-cadmium batteries.
65.	Boric Acid	O-C-265	6810-00-264-6535 6810-00-824-9090 6810-00-153-0191	BT (500 GM) CN (5 LB) BG (25 LB)	Neutralizing potassium hydroxide electrolyte deposits from nickel-cadmium batteries.
66.	Phosphoric Acid, Technical (Orthophosphoric Acid)	A-A-55820 Class 1 (85 percent acid)	 6810-00-264-6722	 BT (2.5 Liters)	One of two components used to make bromothymol blue indicating solution for nickel-cadmium batteries to determine location of contamination (electrolyte spills) and to indicate whether these areas have been completely neutralized.
67.	Bromothymol Blue Indicator Solution	MIL-B-11845	6810-01-031-4757	PT	One of two components in an indicator solution for detecting nickel-cadmium battery spills.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
68.	Litmus Paper	Blue Litmus Paper	6640–00–290–0146	HD (100)	Color change to red indicates acid present (lead acid batteries).
		Red Litmus Paper	6640–00–290–0147	HD (100)	Color change to blue indicates alkali present (nickel–cadmium batteries).
		Paint Removers			
69.	Paint Remover, No Hazardous Air Pollutants (non–HAPs), Thixotropic (MIL–R–81294 alternative)	TT–R–2918, Type I Turco 6813E t	 8010–01–441–6143 8010–01–441–5950	 CN (5 GAL) DR (55 GAL)	Ideal for use in localities where methylene chloride (e.g. MIL–R–81294) based paint removers are restricted or prohibited. Requires a little longer dwell time to lift coatings from parts than MIL–R–81294.
70.	Paint Remover for Epoxy, Polysulfide, and Polyurethane Systems, Thixotropic	MIL–R–81294, Type I Class 1 (Phenolic)	 8010–00–142–9273 8010–00–181–7568 8010–00–926–1488 8010–00–926–1489	 PT (16 OZ) GL (1 GAL) CN (5 GAL) DR (55 GAL)	Removes aircraft paint coatings from metal surfaces. Methylene chloride, phenol, and sodium chromate based paint remover.
		Class 2 (Non–phenolic)	8010–01–261–6067	CN (5 GAL)	Use where phenolic paint removers are NOT allowed.
71.	Paint Remover, Hot Tank, Di–phase (mineral oil seal layer), N–Methyl–2–Pyrrolindone (NMP) and Ethanolamine based (AMS–C–19853 alternative)	MIL–PRF–83936	8010–01–374–4337	DR (55 GAL)	Use for immersion tank paint stripping at Intermediate and Depot level maintenance activities.
72.	Carbon Removing Compound, Methylene Chloride based (Immersion tank application with a water seal layer)	AMS–C–19853 (supersedes MIL–C–19853) Type I (Phenolic), Class 2	 6850–00–543–7801 6850–00–550–7453	 CN (5 GAL) DR (55 GAL)	Removes carbon and paint from components of engines.
		Type II (Non–phenolic), Class 2	6850–01–138–7551 6850–01–138–7550	CN (5 GAL) DR (55 GAL)	Use where phenolic paint removers are NOT allowed.
		Paint Thinners			
73.	Paint thinner for Aircraft Coatings	MIL–T–81772 Type I (Polyurethane thinner)	 8010–00–181–8080 8010–00–181–8079 8010–00–280–1751	 GL (1 GL) CN (5 GL) DR (55 GL)	Use to reduce aircraft paint coatings. Type I of this spec. can be used to prep aircraft surfaces prior to painting, but check with local environmental office for concurrence before using this material as a cleaner/degreaser. Do not use on polycarbonate or acrylic materials.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
73.	(Cont.)	Type II (Epoxy thinner)	8010-01-200-2637 8010-01-212-1704 8010-01-168-0684	GL (1 GL) CN (5 GL) DR (55 GL)	
		Type III (Acrylic and Alkyd thinner)	8010-01-165-6760 8010-01-247-8880	CN (1 GL) DR (55 GL)	
74.	Paint thinner, Mineral Spirits	A-A-2904 (supersedes TT-T-291) Type III (Odorless)	8010-00-837-7969	GL (1 GL)	Use to reduce aircraft paint coatings. Check with local environmental office before using this material to thin paints because its use is limited by emission standards of regulatory agencies.
		Paint - Primers			
75.	Primer Coating: Alkyd Base (Zinc Chromate), One-Component Aerosol (340 g/L VOC max.)	TT-P-1757, Type II, Class C Color Y (Yellow) Color T (Green)	 8010-00-297-0593 8010-00-899-8825	 PT (16 OZ Aerosol) PT (16 OZ Aerosol)	Touch-up of interior aircraft surfaces.
76.	Primer Coating: Polyurethane, Elastomeric, High Solids (340 g/L VOC max.)	TT-P-2760 Type I (Yellow), Class C	 8010-01-357-7868	 KT (1 GAL)	Corrosion inhibited, flexible primer coating for polyurethane topcoats. For use on aircraft (e.g. leading edges) and other equipment (e.g. landing gears) subjected to structural flexing at low temperature.
77.	Primer Coating: Epoxy, High-Solids (340 g/L VOC max.)	MIL-P-23377 Type I (Yellow), Class C	 8010-01-441-6030 8010-01-387-1033 8010-01-387-1069 8010-01-316-2552 8010-01-416-6556 8010-01-416-6557 8010-01-441-5849	 EA (SEMPEN) KT (2 OZ) KT (6 OZ) KT (1 PT) KT (4 PT) KT (1 GAL) KT (4 GAL)	Primer coating for polyurethane topcoat MIL-PRF-85285 and epoxy topcoat MIL-PRF-22750. Use MIL-PRF-23377, Type II as a primer for exterior surfaces requiring tactical or camouflage (flat) paint finish systems. Type II may also be used as an alternate for Type I materials.
		Type II (Green), Class C	8010-01-441-6031 8010-01-439-0683 8010-01-437-8657 8010-01-417-1215 8010-01-312-1172	EA (SEMPEN) KT (3 OZ) KT (4 PT) KT (1 GAL) KT (2 GAL)	

Item No.	Nomenclature	Specifications/Part No.		National Stock Number	Unit of Issue	Intended Use
78.	Primer Coating: Epoxy, Water-borne (340 g/L VOC max.)	MIL-PRF-85582				Primer coating for polyurethane topcoat MIL-PRF-85285 and epoxy topcoat MIL-PRF-22750. Use MIL-PRF-85582, Type II as a primer for exterior surfaces requiring tactical or camouflage (flat) paint finish systems. Type II may also be used as an alternate for Type I materials.
		Type I, Class C1		8010-01-441-6142	KT (1 QT *)	
				8010-01-218-0856	KT (1 QT**)	
				8010-01-218-7354	KT (1 GAL)	
		Type I, Class C2		8010-01-441-6032	EA (SEMPEN)	**NOTE:**
				8010-01-292-8894	KT (1 QT**)	* after thinning with water (Dilute)
				8010-01-292-8893	KT (1 GAL)	** before thinning with water (Concentrate)
		Type I, Class N		8010-01-466-9307	KT (2 GAL)	
		Type II, Class C1		8010-01-441-6141	KT (1 QT *)	Use of Class N of Types I & II (non-chromate based corrosion inhibitors) requires authorization from the cognizant Type, Model, and Series (TMS) engineering authority of the aircraft.
				8010-01-218-0858	KT (1 QT**)	
				8010-01-218-0857	KT (1 GAL)	
		Type II, Class C2		8010-01-441-6033	EA (SEMPEN)	
				8010-01-266-6576	KT (1 PT)	
				8010-01-294-7781	KT (1 GAL)	
		Type II, Class N		8010-01-466-9313	KT (2 GAL)	
				Paint - Topcoats		
79.	Topcoat Coating: Polyurethane, High-Solids, Aircraft Application (420 g/L VOC max.)	MIL-PRF-85285, Type I (Aircraft application)				Finishing or touch-up of aircraft polyurethane topcoat paint systems. Suitable for use over primers (i.e., TT-P-2760, MIL-PRF-23377, and MIL-PRF-85582).
		Gloss	**Color**			
		Clear	-------	8010-01-441-6017	EA (SEMPEN)	
		Red	11136	8010-01-441-6018	EA (SEMPEN)	
				8010-01-265-9154	KT (2 QT)	
				8010-01-265-9139	KT (2 GAL)	
		Orange, Int'l.	12197	8010-01-441-6019	EA (SEMPEN)	
				8010-01-329-6301	KT (2 QT)	
				8010-01-329-7263	KT (2 GAL)	
		Orange-Yellow	13538	8010-01-441-6003	EA (SEMPEN)	
				8010-01-285-3038	KT (2 QT)	
				8010-01-265-9153	KT (2 GAL)	
		Green	14187	8010-01-285-3040	KT (2 QT)	
				8010-01-285-3041	KT (2 GAL)	
		Blue	15044	8010-01-441-6004	EA (SEMPEN)	
				8010-01-329-6304	KT (2 QT)	
		Blue	15050	8010-01-441-6005	EA (SEMPEN)	
		Blue	15180	8010-01-285-3043	KT (2 QT)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.		National Stock Number	Unit of Issue	Intended Use
79.	(Cont.)	**Gloss**	**Color**			
		Gray, Dark	16081	8010-01-285-3044	KT (2 GAL)	
				8010-01-329-6753	KT (1 PT)	
				8010-01-329-6302	KT (2 QT)	
		Gray, Light	16440	8010-01-329-6303	KT (2 GAL)	
				8010-01-459-9699	EA (SEMPEN)	
				8010-01-285-3045	KT (1 PT)	
				8010-01-285-3046	KT (2 QT)	
		Gray, Light	16473	8010-01-265-9142	KT (2 GAL)	
				8010-01-441-6020	EA (SEMPEN)	
				8010-01-336-3033	KT (2 QT)	
		Black	17038	8010-01-336-3032	KT (2 GAL)	
				8010-01-441-6026	EA (SEMPEN)	
				8010-01-285-3048	KT (2 QT)	
		White, Insignia	17925	8010-01-285-3033	KT (2 GAL)	
				8010-01-441-6029	EA (SEMPEN)	
				8010-01-285-3034	KT (1 PT)	
				8010-01-285-3035	KT (2 QT)	
				8010-01-265-9143	KT (2 GAL)	
		Semi-gloss	**Color**			
		Green	24052	8010-01-441-6006	EA (SEMPEN)	
		Gray	26231	8010-01-441-6007	EA (SEMPEN)	
				8010-01-285-7285	KT (2 QT)	
				8010-01-285-2489	KT (2 GAL)	
		Gray	26250	8010-01-441-6035	EA (SEMPEN)	
		Gray	26251	8010-01-441-6034	EA (SEMPEN)	
		Flat	**Color**			
		Red	31136	8010-01-441-6008	EA (SEMPEN)	
		Orange-Yellow	33538	8010-01-441-6009	EA (SEMPEN)	
		Green, Field	34095	8010-01-285-7286	KT (2 QT)	
				8010-01-265-9141	KT (2 GAL)	
		Green	34097	8010-01-285-2492	KT (2 QT)	
				8010-01-285-2493	KT (2 GAL)	
		Blue	35044	8010-01-441-6010	EA (SEMPEN)	
		Blue-Gray	35237	8010-01-441-6011	EA (SEMPEN)	
				8010-01-285-2494	KT (1 PT)	
				8010-01-285-2495	KT (2 QT)	
				8010-01-265-9140	KT (2 GAL)	

Item No.	Nomenclature	Specifications/Part No.		National Stock Number	Unit of Issue	Intended Use
79.	(Cont.)	**Flat**	**Color**			
		Gray, Dark	36081	8010-01-397-3974	KT (2 QT)	
				8010-01-397-3975	KT (2 GAL)	
		Gray	36118	8010-01-441-6021	EA (SEMPEN)	
				8010-01-305-5554	KT (1 PT)	
				8010-01-305-5550	KT (2 QT)	
				8010-01-305-5551	KT (2 GAL)	
		Gray	36173	8010-01-441-6022	EA (SEMPEN)	
		Gray-Blue	36176	8010-01-441-6012	EA (SEMPEN)	
		Gray, Medium	36231	8010-01-441-6027	EA (SEMPEN)	
				8010-01-329-6756	KT (1 PT)	
				8010-01-329-6755	KT (2 QT)	
				8010-01-466-4323	KT (1 GAL)	
				8010-01-329-6752	KT (2 GAL)	
		Gray	36251	8010-01-441-6013	EA (SEMPEN)	
		Gray	36270	8010-01-441-6023	EA (SEMPEN)	
		Gray	36293	8010-01-441-6014	EA (SEMPEN)	
		Gray, Medium	36320	8010-01-441-6024	EA (SEMPEN)	
				8010-01-285-3556	KT (1 PT)	
				8010-01-265-9144	KT (2 QT)	
				8010-01-265-9152	KT (2 GAL)	
		Gray, Medium	36375	8010-01-441-6025	EA (SEMPEN)	
				8010-01-285-7287	KT (1 PT)	
				8010-01-265-9145	KT (2 QT)	
				8010-01-265-9151	KT (2 GAL)	
		Gray, Light	36440	8010-01-265-9138	KT (2 QT)	
				8010-01-466-4322	KT (1 GAL)	
				8010-01-265-9150	KT (2 GAL)	
		Gray, Aircraft	36495	8010-01-441-6015	EA (SEMPEN)	
				8010-01-285-3552	KT (1 PT)	
				8010-01-265-9137	KT (2 QT)	
				8010-01-265-9149	KT (2 GAL)	
		Black	37038	8010-01-441-6028	EA (SEMPEN)	
				8010-01-285-3554	KT (2 QT)	
				8010-01-285-3555	KT (2 GAL)	
		White, Insignia	37875	8010-01-441-6016	EA (SEMPEN)	
		White	37886	8010-01-459-9697	EA (SEMPEN)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.		National Stock Number	Unit of Issue	Intended Use
80.	Polyurethane Topcoat Coating: Self-Priming Topcoat (SPT), Low Volatile Organic Compound (420 g/L VOC max.)	TT-P-2756				Use on aircraft surfaces in lieu of standard primer and topcoat paint systems. This coating may be used only when approved by the engineering authority for the surface or component requiring painting. This material shall not be used directly on load bearing steel (i.e., landing gear, etc.) and magnesium components.
		Gloss	**Color**			
		Red	11136	8010-01-354-0977	KT (2 QT)	
				8010-01-353-3697	KT (2 GAL)	
		Orange, Int'l.	12197	8010-01-354-0982	KT (2 QT)	
				8010-01-353-4953	KT (2 GAL)	
		Orange-Yellow	13538	8010-01-354-0976	KT (2 QT)	
				8010-01-353-3696	KT (2 GAL)	
		Yellow	13670	8010-01-357-4754	KT (2 QT)	
				8010-01-357-4755	KT (2 GAL)	
		Yellow	13655	8010-01-358-3426	KT (2 QT)	
				8010-01-358-3427	KT (2 GAL)	
		Green	14052	8010-01-362-3200	KT (2 QT)	
				8010-01-362-3201	KT (2 GAL)	
		Blue	15044	8010-01-354-0979	KT (2 QT)	
				8010-01-353-4950	KT (2 GAL)	
		Blue	15045	8010-01-357-4752	KT (2 QT)	
				8010-01-357-4753	KT (2 GAL)	
		Blue	15180	8010-01-354-0980	KT (2 QT)	
				8010-01-353-4951	KT (2 GAL)	
		Blue	15200	8010-01-354-0971	KT (2 QT)	
				8010-01-353-4948	KT (2 GAL)	
		Gray	16251	8010-01-358-3423	KT (2 QT)	
				8010-01-358-4331	KT (2 GAL)	
		Gray, Light	16440	8010-01-354-0959	KT (2 QT)	
				8010-01-340-7061	KT (2 GAL)	
		Gray	16473	8010-01-354-0967	KT (2 QT)	
				8010-01-344-3220	KT (2 GAL)	
		Black	17038	8010-01-354-0981	KT (2 QT)	
				8010-01-353-4952	KT (2 GAL)	
		White, Insignia	17925	8010-01-354-0966	KT (2 QT)	
				8010-01-343-1395	KT (2 GAL)	
		Semi-gloss	**Color**			
		Green	24052	8010-01-354-0968	KT (2 QT)	
				8010-01-344-3221	KT (2 GAL)	
		Gray	26231	8010-01-354-0972	KT (2 QT)	
				8010-01-353-5756	KT (2 GAL)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.		National Stock Number	Unit of Issue	Intended Use
80.	(Cont.)	**Flat**	**Color**			
		Brown	30140	8010–01–376–3702	KT (2 QT)	
				8010–01–376–3703	KT (2 GAL)	
		Brown	30219	8010–01–376–3708	KT (2 QT)	
				8010–01–376–3709	KT (2 GAL)	
		Brown	30279	8010–01–376–3710	KT (2 QT)	
				8010–01–376–3711	KT (2 GAL)	
		Tan	30318	8010–01–380–3239	KT (2 GAL)	
		Tan	30475	8010–01–376–3704	KT (2 QT)	
				8010–01–376–3705	KT (2 GAL)	
		Tan	33613	8010–01–375–4554	KT (2 QT)	
		Green	34086	8010–01–354–0970	KT (2 QT)	
				8010–01–345–6534	KT (2 GAL)	
		Green, Field	34095	8010–01–354–0962	KT (2 QT)	
		Green	34097	8010–01–354–0973	KT (2 QT)	
				8010–01–353–3693	KT (2 GAL)	
		Gray	35164	8010–01–375–4560	KT (2 QT)	
		Blue	35109	8010–01–376–3706	KT (2 QT)	
		Blue	35190	8010–01–376–3700	KT (2 QT)	
				8010–01–376–3701	KT (2 GAL)	
		Blue–Gray	35237	8010–01–354–0961	KT (2 QT)	
				8010–01–340–8714	KT (2 GAL)	
		Blue	35450	8010–01–423–3635	KT (2 QT)	
				8010–01–423–3638	KT (2 GAL)	
		Gray	36081	8010–01–354–0965	KT (2 QT)	
				8010–01–341–0795	KT (2 GAL)	
		Gray	36118	8010–01–354–0969	KT (2 QT)	
				8010–01–344–3222	KT (2 GAL)	
		Gray	36173	8010–01–354–0983	KT (2 QT)	
				8010–01–353–4947	KT (2 GAL)	
		Gray	36231	8010–01–372–3960	KT (2 QT)	
				8010–01–368–8515	KT (2 GAL)	
		Gray, Medium	36320	8010–01–354–0963	KT (2 QT)	
				8010–01–340–8716	KT (2 GAL)	
		Gray, Medium	36375	8010–01–354–0964	KT (2 QT)	
				8010–01–340–8717	KT (2 GAL)	
		Gray, Light	36440	8010–01–354–0974	KT (2 QT)	
		Gray, Aircraft	36495	8010–01–354–0975	KT (2 QT)	
				8010–01–353–3695	KT (2 GAL)	
		Black	37038	8010–01–354–0960	KT (2 QT)	
				8010–01–340–8713	KT (2 GAL)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.		National Stock Number	Unit of Issue	Intended Use
81.	Topcoat Coating: Epoxy, High-Solids (340 g/L VOC max.)	MIL-PRF-22750				Alternate topcoat for touch-up of polyurethane paint systems. Also can be used as a topcoat for interior surfaces.
		Gloss	**Color**			
		Clear	-------	8010-01-313-8702	KT (1 QT)	
			-------	8010-01-419-1143	KT (2 QT)	
			-------	8010-01-419-1141	KT (4 QT)	
			-------	8010-01-313-8703	KT (2 GAL)	
		Brown	10049	8010-01-414-8450	KT (2 QT)	
		Red, Insignia	11136	8010-01-441-5890	KT (1 QT)	
				8010-01-419-1170	KT (2 QT)	
				8010-01-313-7284	KT (2 GAL)	
		Orange, Int'l.	12197	8010-01-441-5892	KT (1 QT)	
				8010-01-419-1160	KT (2 QT)	
				8010-01-419-1158	KT (4 QT)	
		Orange-Red	12199	8010-01-414-8448	KT (2 QT)	
		Orange-Yellow	13538	8010-01-441-5895	KT (1 QT)	
				8010-01-419-1169	KT (2 QT)	
				8010-01-419-1156	KT (4 QT)	
		Green	14062	8010-01-414-8451	KT (2 GAL)	
		Green, Olive Drab	14084	8010-01-414-8442	KT (2 QT)	
		Green, Field	14097	8010-01-414-8449	KT (2 QT)	
		Green	14187	8010-01-414-8420	KT (2 GAL)	
		Blue, Insignia	15044	8010-01-419-1168	KT (2 QT)	
		Blue	15102	8010-01-441-5896	KT (1 QT)	
				8010-01-414-8424	KT (2 QT)	
		Blue, Light	15526	8010-01-414-8427	KT (2 QT)	
		Gray, Engine	16081	8010-01-419-1167	KT (2 QT)	
				8010-01-441-5898	KT (1 GAL)	
				8010-01-419-1166	KT (2 GAL)	
		Gray, Gull	16440	8010-01-441-5899	KT (1 QT)	
				8010-01-419-1163	KT (2 QT)	
		Gray, Light	16473	8010-01-414-8423	KT (2 QT)	
		Black	17038	8010-01-441-5900	KT (1 QT)	
				8010-01-419-1154	KT (2 QT)	
				8010-01-419-1165	KT (4 QT)	
		Magenta	17142	8010-01-414-8421	KT (2 QT)	
		White	17875	8010-01-414-8439	KT (2 QT)	
		White, Insignia	17925	8010-01-441-5905	KT (1 QT)	
				8010-01-419-1153	KT (2 QT)	
				8010-01-419-1164	KT (4 QT)	
				8010-01-313-8701	KT (2 GAL)	
				8010-01-419-1159	KT (4 GAL)	

Item No.	Nomenclature	Specifications/Part No.		National Stock Number	Unit of Issue	Intended Use
81.	(Cont.)	**Semi-gloss**	**Color**			
		Green, Dark	24052	8010-01-414-8438	KT (2 QT)	
		Green	24410	8010-01-414-8422	KT (2 QT)	
		Gray, Seaplane	26081	8010-01-414-8440	KT (2 GAL)	
		Gray	26231	8010-01-414-8428	KT (2 QT)	
		Gray	26307	8010-01-441-5916	KT (1 QT)	
				8010-01-414-8429	KT (2 QT)	
		Gray, Light	26492	8010-01-414-8445	KT (2 GAL)	
		Flat	**Color**			
		Red, Insignia	31136	8010-01-414-8426	KT (2 QT)	
		Green, Dark	34064	8010-01-414-8437	KT (2 QT)	
		Green, Battle	34079	8010-01-414-8444	KT (2 GAL)	
		Green	34088	8010-01-419-1151	KT (4 QT)	
		Blue, Insignia	35044	8010-01-414-8431	KT (2 QT)	
		Blue	35190	8010-01-414-8436	KT (2 QT)	
		Gray-Blue	35237	8010-01-441-5920	KT (1 QT)	
				8010-01-419-1145	KT (2 QT)	
				8010-01-419-1157	KT (1 GAL)	
		Blue, Light	35450	8010-01-414-8433	KT (2 QT)	
		Gray, Dark	36081	8010-01-441-6080	KT (4 QT)	
		Gray	36099	8010-01-414-8434	KT (2 QT)	
		Gray	36231	8010-01-441-5921	KT (1 QT)	
				8010-01-414-8446	KT (2 QT)	
				8010-01-419-1150	KT (1 GAL)	
		Gray	36320	8010-01-441-5924	KT (1 QT)	
				8010-01-419-1155	KT (2 QT)	
				8010-01-419-1140	KT (1 GAL)	
		Gray	36375	8010-01-441-5930	KT (1 QT)	
				8010-01-419-1152	KT (2 QT)	
				8010-01-419-1146	KT (1 GAL)	
		Gray, Gull	36440	8010-01-414-8447	KT (4 QT)	
		Gray, Light	36495	8010-01-441-5931	KT (1 QT)	
				8010-01-419-1149	KT (2 QT)	
				8010-01-419-1144	KT (1 GAL)	
		Black	37038	8010-01-441-5932	KT (1 QT)	
				8010-01-419-1142	KT (2 QT)	
				8010-01-414-8443	KT (1 GAL)	
		Insignia White	37875	8010-01-414-8435	KT (2 QT)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.		National Stock Number	Unit of Issue	Intended Use
82.	Topcoat Coating: Aircraft Touch-Up (340 g/L VOC max.)	MIL-PRF-81352 Type I (Acrylic base)				One-component topcoat for general touch-up and temporary markings. In regulated VOC areas, use only coatings conforming to TT-P-2756, MIL-PRF-22750, or MIL-PRF-85285.
		Gloss	**Color**			
		Clear	-------	8010-00-490-7651	CN (1 GAL)	
		Brown	10049	8010-00-935-7061	CN (1 QT)	
		Red	11105	8010-01-029-6349	CN (1 QT)	
		Red, Insignia	11136	8010-00-935-7064	CN (16 OZ Aerosol)	
				8010-00-935-7063	CN (1 QT)	
				8010-00-935-7062	CN (1 GAL)	
		Orange, Int'l.	12197	8010-00-935-7066	CN (1 QT)	
				8010-00-935-7065	CN (1 GAL)	
		Orange-Yellow	13538	8010-00-935-7068	CN (1 QT)	
				8010-00-935-7067	CN (1 GAL)	
		Green, Olive Drab	14084	8010-00-935-7069	CN (1 QT)	
		Green, Olive Drab	14097	8010-00-133-5901	CN (16 OZ Aerosol)	
		Green, Light	14187	8010-00-935-7071	CN (1 QT)	
				8010-00-935-7070	CN (1 GAL)	
		Blue, Dark	15044	8010-00-935-7072	CN (1 GAL)	
		Blue	15045	8010-00-490-7649	CN (1 GAL)	
		Blue	15102	8010-00-935-7073	CN (1 GAL)	
		Gray, Engine	16081	8010-00-935-7075	CN (16 OZ Aerosol)	
		Gray	16440	8010-00-181-7791	CN (16 OZ Aerosol)	
				8010-01-088-0104	CN (1 QT)	
		Gray, Aircraft	16473	8010-00-935-7076	CN (1 GAL)	
		Black	17038	8010-00-935-7078	CN (1 QT)	
				8010-00-935-7077	CN (1 GAL)	
		White, Insignia	17875	8010-00-935-6609	CN (16 OZ Aerosol)	
				8010-00-935-6608	CN (1 GAL)	
		Semi-gloss	**Color**			
		Gray	26373	8010-01-303-0237	CN (1 GAL)	
		Gray, Eggshell	26622	8010-01-466-1658	CN (16 OZ Aerosol)	
		Black	27038	8010-00-104-7711	CN (1 GAL)	
		White	27875	8010-00-104-7745	CN (1 GAL)	
		Flat	**Color**			
		Brown	30219	8000-00-066-9440	CN (1 GAL)	
		Red	31136	8010-00-066-9431	CN (1 GAL)	
		Beige	33531	8010-01-306-6677	CN (1 GAL)	
		Orange-Yellow	33538	8010-01-157-2292	CN (1 GAL)	
		Green, Olive Drab	33070	8010-00-490-7650	CN (1 GAL)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.		National Stock Number	Unit of Issue	Intended Use
82.	(Cont.)	**Flat**	**Color**			
		Green, Olive Drab	34079	8010-00-068-8779	CN (1 GAL)	
		Green, Olive Drab	34088	8010-00-144-9998	CN (1 QT)	
		Green	34102	8010-00-068-8783	CN (1 GAL)	
		Blue, Insignia	35044	8010-00-066-9430	CN (1 GAL)	
		Gray-Blue	35237	8010-01-270-3636	CN (1 GAL)	
		Gray, Dark	36081	8010-01-270-3631	CN (1 GAL)	
		Gray, Dark	36118	8010-01-270-3632	CN (1 GAL)	
		Gray	36231	8010-01-124-5048	CN (16 OZ Aerosol)	
				8010-01-150-9907	CN (1 GAL)	
		Gray, Light	36270	8010-01-270-3633	CN (1 GAL)	
		Gray, Gull	36440	8010-00-935-7085	CN (16 OZ Aerosol)	
				8010-00-935-7060	CN (1 GAL)	
		Gray	36118	8010-01-270-3632	CN (1 GAL)	
		Gray	36320	8010-01-270-3634	CN (1 GAL)	
		Gray	36492	8010-01-270-3635	CN (1 GAL)	
		Gray	36622	8010-00-068-8786	CN (1 GAL)	
		White, Insignia	37875	8010-00-068-8778	CN (1 GAL)	
		White	37886	8010-01-303-0236	CN (1 GAL)	
		Black	37038	8010-00-935-7079	CN (16 OZ Aerosol)	
				8010-00-830-1822	CN (1 GAL)	
83.	Topcoat Coating: Elastomeric, Polyurethane, Rain-Erosion (420 g/L VOC max.)	MIL-C-85322				Application or repair of erosion resistant coatings for exterior aircraft structures (e.g. leading edges). Can be applied over primers conforming to TT-P-2760, MIL-PRF-23377, or MIL-PRF-85582.
		Flat	**Color**			
		Gray	36375	8010-01-054-7224	KT (1 QT)	
				8010-01-054-7228	KT (1 GAL)	
				8010-01-054-7225	KT (5 GAL)	
		Black	37038	8010-01-054-7229	KT (1 QT)	
84.	Walkway Coating, Non-Slip (420 g/L VOC max.)	A-A-59166 (supersedes MIL-W-5044) Type II (Rough Texture)				Application and repair of non-slip walkway coatings.
		Semi-gloss	**Color**			
		Blue-Green	25414	8010-00-151-4903	GL	
		Flat	**Color**			
		Green, Olive Drab	34088	8010-00-141-7838	GL	
		Gray, Dark	36081	8010-00-599-9201	GL	
		Gray, Dark Gull	36231	8010-00-641-0426	GL	
		Gray	36251	8010-01-280-5130	GL	
		Gray, Light Gull	36440	8010-00-141-7842	GL	
		Black	37038	8010-00-142-6525	QT	
				8010-00-641-0427	GL	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
85.	Coating: Aluminum Paint, Heat Resistant (1200_F)	TT-P-28 Gray (Color # 17178)	 8010-00-664-7468 8010-00-815-2692 8010-00-857-1938	 QT GL CN (5 GAL)	Used on areas where temperatures exceed 350_F. VOC exceeds 420 g/L.
86.	Polyurethane Coating: Erosion Resistant Conductive Coating (Black in color)	P/N: 8-B-6 (LAMINAR X-500)	8010-00-908-0362	KT	Used on composite surfaces to provide electrical continuity and erosion resistance. Kit consist of 1 quart of base resin and ½ pint of catalyst. VOC exceeds 420 g/L.
		Protective Materials			
87.	Barrier Material, Flexible, Greaseproof, Waterproof	MIL-B-121, Grade A, Class 1 Type I (Heavy duty) Type II (Medium duty)	 8135-00-292-9719 8135-00-233-3871 8135-00-224-8885	 RO (36” x 100 YD) RO (36” x 200 YD) RO (36” x 200 YD)	General purpose masking material used for protecting equipment and supplies during transportation and storage under all climate conditions.
88.	Barrier Material, Flexible, Greaseproof, Water Resistant, Heat-Sealable	MIL-PRF-131, Class 1	8135-00-282-0565	RO (36” x 200 YD)	Use for aircraft preservation (e.g. sealing aircraft openings, protection of canopies, temporary walkway protection).
89.	Kraft Paper, Untreated (Brown in color)	A-A-203 (supersedes UU-P-268) **Style 1 (Rolls)** 50 pound weight 60 pound weight 70 pound weight 80 pound weight **Style 1 (Sheets)** 30 pound weight (850 Sheets) 70 pound weight (200 Sheets)	 8135-01-337-5370 8135-00-160-7764 8135-00-160-7768 8135-00-160-7769 8135-00-160-7771 8135-00-160-7772 8135-00-160-7776 8135-00-160-7778 8135-00-290-3408 8135-00-290-5504	 RO (3’ x 200’) RO (3’ x 980’) RO (3’ x 820’) RO (4’ x 820’) RO (3’ x 700’) RO (4’ x 700’) RO (3’ x 615’) RO (4’ x 615’) SH (2’ x 3’) SH (3’ x 4’)	General wrapping applications and protection of surrounding surface areas during grit media blasting, paint spraying, sealant application, etc.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
90.	Paint Masking Paper with adhesive back (Light brown in color)	Ready–Mask t (3M No. 850DC)	Open Purchase Open Purchase Open Purchase	RO (2” x 180’) RO (3” x 400’) RO (3.25” x 75’)	Paper masking tape with adhesive along one edge. Protects surfaces from paint splatters and overspray. Easy to apply and comes off cleanly with no adhesive transfer.
91.	Plastic Sheet and Strip, Clear, Polyolefin	A–A–3174 (supersedes L–P–378)	8135–01–066–3217	RO (6’ x 100’)	Protection of acrylic canopies during washing operations.
92.	Aircraft Preservation and Sealing Tape (Black in color)	AMS–T–22085, Type II (3M No. 481)	7510–00–852–8179 7510–00–852–8180 7510–00–885–3510 7510–00–926–8939 7510–00–916–9659 7510–00–926–8941	RO (1” x 36 YD) RO (2” x 36 YD) RO (2.5” x 36 YD) RO (3” x 36 YD) RO (4” x 36 YD) RO (6” x 36 YD)	One–sided plastic preservation and sealing tape used for holding most barrier material in place during storage or shipment. Effective for many outdoor applications and can be used on metals or painted surfaces with clean removal up to 2 years after initial use. **NOTE:** Do not use on acrylic or polycarbonate canopies and windscreens.
93.	Paint Masking Tape, Crepe Paper Treated (Natural colored)	AMS–T–21595, Type I (3M No. 231)	7510–01–371–3239 7510–01–371–3234 7510–01–371–3238 7510–01–371–3236 7510–01–371–3237 7510–01–371–3235	RO (1/2” x 60 YD) RO (3/4” x 60 YD) RO (1” x 60 YD) RO (1.5” x 60 YD) RO (2” x 60 YD) RO (3” x 60 YD)	Conformable tape used for masking prior to painting and sealant applications. Tape can be used at baking temperatures up to 250_F for one hour and can be removed without adhesive transfer. Tape shall not be subjected to outdoor exposure or prolonged periods of sunlight.
94.	Fine Line Tape, Plastic Film with Matte Finish (Light Green in color)	AMS–T–21595, Type III (3M No. 218)	7510–01–158–0035 7510–01–158–6606 7510–01–158–7778 7510–01–158–6605 7510–01–158–6604 7510–01–158–6603 7510–01–158–6607	RO (1/4” x 60 YD) RO (1/2” x 60 YD) RO (3/4” x 60 YD) RO (1” x 60 YD) RO (1.5” x 60 YD) RO (2” x 60 YD) RO (3” x 60 YD)	One–sided thin plastic tape used for fine line masking during paint touchup and for other masking and holding applications. Tape shall not be subjected to outdoor exposure or prolonged periods of sunlight because the tape will become very difficult to remove.
95.	Aluminum Foil Tape, Chemical and Water Resistant (Shiny Silver in color)	AMS–T–23397, Type II (3M No. 425)	7510–00–806–4669 7510–00–654–9811 7510–00–720–7516 7510–00–684–8803 7510–00–816–8077 7510–00–982–3955 7510–00–179–0662	RO (1/2” x 60 YD) RO (3/4” x 60 YD) RO (1” x 60 YD) RO (2” x 60 YD) RO (3” x 60 YD) RO (4” x 60 YD) RO (6” x 60 YD)	Maskant material used for protecting surrounding surfaces during paint removal operations. Aluminum backing provides excellent reflection of both heat and light. Tape can be used in or outdoors for many long term applications. Use tape and decal applicator (P/N: P.A.–1) to apply this tape to surfaces.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
96.	Flatback Masking Tape (Tan in color)	A–A–883, Type II (supersedes PPP–T–250) (3M No. 250)	7510–01–026–4661 7510–00–290–2024 7510–00–283–0612 7510–00–290–2027 7510–00–290–2026 7510–00–266–6694	RO (1/2” x 60 YD) RO (3/4” x 60 YD) RO (1” x 60 YD) RO (1.5” x 60 YD) RO (2” x 60 YD) RO (3” x 60 YD)	The solvent resistance of this tape makes it ideal for straight line paint masking operations. The 1” of this tape (No. 250) is usually used for the paint pull adhesion test. Because of its high strength, it is good for holding, bundling, and wrapping on a variety of surfaces. It is not recommended for outdoor exposure because it becomes very difficult to remove.
97.	Plastic Media Blasting (PMB) Tape, Impact Resistant (Light Green in color)	3M No. 500	7510–01–300–2124 7510–01–300–2125 7510–01–300–2126 7510–01–300–2127	RO (1” x 10 YD) RO (2” x 10 YD) RO (3” x 10 YD) RO (4” x 10 YD)	Masking and protecting aircraft surfaces during grit media blasting.
98.	Applicator, Tape and Decal (made of hard plastic)	3M No. P.A.–1 (4”L x 2–3/4”W with tapered edges)	5120–00–628–5569	BX (25)	Ideal for use to apply masking tapes (esp. aluminum foil tape), anti–erosion leading edge tape, decals, etc.
		Sealants and Sealant Accessories KT – Two–Part Can Kit (Base and Accelerator) OZ – Premixed and Frozen (PMF) CA – Semkit Cartridge			
99.	Sealing and Coating Compound, Corrosion Inhibitive, Polysulfide Rubber	MIL–PRF–81733 **Type I (Brush or dip application)** I–1/2 I–2 **Type II (Gun or spatula application)** II–1/2	 8030–00–008–7207 8030–00–009–5022 8030–01–372–2984 8030–01–372–2985 8030–00–008–7196 8030–00–762–8807 8030–01–363–6501 8030–01–361–1814 8030–00–008–7198 8030–00–470–9154 8030–01–387–0244 8030–01–387–1017 8030–01–184–0328 8030–01–184–0329	 KT (12 OZ, TWO–PART) KT (24 OZ, TWO–PART) OZ (2.5 OZ, FROZEN) OZ (6 OZ, FROZEN) KT (12 OZ, TWO–PART) KT (24 OZ, TWO–PART) OZ (6 OZ, FROZEN) CA (6 OZ, SEMKIT) KT (12 OZ, TWO–PART) KT (24 OZ, TWO–PART) OZ (2.5 OZ, FROZEN) OZ (6 OZ, FROZEN) CA (2.5 OZ, SEMKIT) CA (6 OZ, SEMKIT)	Used for sealing faying surfaces and wet installation of fasteners on permanent structures. It is also the preferred sealant for form in–place (FIP) seals on doors, removable panels, and sealing gaps and seams. Do not use on inside of integral fuel tanks.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
99.	(Cont.)	**Type II (Gun or spatula application)**			
		II-2	8030-01-124-7622	KT (6 OZ, TWO-PART)	
			8030-00-009-5023	KT (12 OZ, TWO-PART)	
			8030-00-008-7200	KT (24 OZ, TWO-PART)	
			8030-01-333-3954	OZ (2.5 OZ, FROZEN)	
			8030-01-333-4821	OZ (6 OZ, FROZEN)	
			8030-01-196-1958	CA (2.5 OZ, SEMKIT)	
			8030-01-184-0330	CA (6 OZ, SEMKIT)	
		II-4	8030-00-008-7201	KT (12 OZ, TWO-PART)	
			8030-00-008-7202	KT (24 OZ, TWO-PART)	
		Type III (Spray gun application)			
		III-1	8030-00-008-7203	KT (12 OZ, TWO-PART)	
			8030-00-008-7204	KT (24 OZ, TWO-PART)	
			8030-00-871-8489	KT (96 OZ, TWO-PART)	
		Type IV (Extended assembly time)			
		IV-12	8030-01-395-2726	KT (12 OZ, TWO-PART)	
			8030-00-151-9973	KT (96 OZ, TWO-PART)	
		IV-24	8030-01-395-2728	KT (12 OZ, TWO-PART)	
			8030-00-008-7206	KT (24 OZ, TWO-PART)	
			8030-01-363-6503	OZ (6 OZ, FROZEN)	
		IV-48	8030-01-192-2807	KT (6 OZ, TWO-PART)	
			8030-01-395-2729	KT (12 OZ, TWO-PART)	
			8030-00-028-8495	KT (24 OZ, TWO-PART)	
			8030-01-363-6504	OZ (6 OZ, FROZEN)	
100.	Sealing Compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion (Polysulfide)	AMS-S-8802, Type II (Manganese cured)			Use for filleting and brush sealing of integral fuel tanks and fuel cell cavities. Type I (Dichromate cured) is cancelled. Type II (Manganese cured) sealing materials are authorized for all previous uses of Type I.
		Class A (Brush or dip application)			
		A-1/2	8030-00-753-4596	KT (6 OZ, TWO-PART)	
			8030-00-965-2004	KT (12 OZ,TWO-PART)	
			8030-01-387-3196	OZ (2.5 OZ, FROZEN)	
			8030-00-753-5008	CA (2.5 OZ, SEMKIT)	
			8030-00-753-5010	CA (6 OZ, SEMKIT)	
		A-1	8030-01-386-3656	KT (24 OZ, TWO-PART)	
		A-2	8030-00-753-4598	KT (6 OZ, TWO-PART)	
			8030-00-753-5343	KT (12 OZ, TWO-PART)	
			8030-00-723-5344	KT (24 OZ, TWO-PART)	
			8030-00-841-6832	KT (96 OZ, TWO-PART)	
			8030-01-363-6671	OZ (2.5 OZ, FROZEN)	
			8030-01-363-6505	OZ (6 OZ, FROZEN)	
			8030-00-753-5003	CA (2.5 OZ, SEMKIT)	
			8030-00-753-5009	CA (6 OZ, SEMKIT)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
100.	(Cont.)	**Class B (Gun or spatula application)**			
		B-1/2	8030-00-753-4597	KT (6 OZ, TWO-PART)	
			8030-00-174-2599	KT (12 OZ, TWO-PART)	
			8030-00-080-1549	KT (24 OZ, TWO-PART)	
			8030-00-753-5007	CA (2.5 OZ, SEMKIT)	
			8030-00-753-5004	CA (6 OZ, SEMKIT)	
		B-1	8030-01-337-9408	CA (2.5 OZ, SEMKIT)	
		B-2	8030-00-753-4599	KT (6 OZ, TWO-PART)	
			8030-00-723-2746	KT (12 OZ, TWO-PART)	
			8030-00-685-0915	KT (24 OZ, TWO-PART)	
			8030-00-579-8453	KT (96 OZ, TWO-PART)	
			8030-01-333-4823	OZ (2.5 OZ, FROZEN)	
			8030-01-333-4822	OZ (6 OZ, FROZEN)	
			8030-00-753-5006	CA (2.5 OZ, SEMKIT)	
			8030-00-753-5005	CA (6 OZ, SEMKIT)	
		B-4	8030-00-174-2598	KT (12 OZ, TWO-PART)	
			8030-00-850-5717	KT (24 OZ, TWO-PART)	
			8030-00-850-0759	CA (2.5 OZ, SEMKIT)	
			8030-00-850-0758	CA (6 OZ, SEMKIT)	
		Class C (Extended assembly time)			
		C-20	8030-01-048-3772	KT (12 OZ, TWO-PART)	
			8030-00-427-2661	KT (96 OZ, TWO-PART)	
			8030-00-152-0012	CA (6 OZ, SEMKIT)	
		C-80	8030-00-709-3278	KT (24 OZ, TWO-PART)	
			8030-00-432-1544	KT (96 OZ, TWO-PART)	
101.	Sealing Compound, Integral Fuel Tanks, Cell Cavities, and General Purpose, High Temperature Applications (Polysulfide)	AMS 3276 (supersedes MIL-S-83430)			Used for fuel tank sealing, cabin pressure sealing, aerodynamic smoothing, faying surface sealing, wet-installation and overcoating of fasteners, sealing joints and seams, and non-structural adhesive bonding. For fuel tank applications, treat bond surfaces with AMS 3100 adhesion promoter to enhance sealant adhesion.
		Class A (Brush or dip application)			
		A-1/2	8030-00-602-0107	KT (6 OZ, TWO-PART)	
			8030-01-395-5474	KT (12OZ, TWO-PART)	
			8030-01-036-6936	KT (24OZ, TWO-PART)	
			8030-00-312-6128	CA (6 OZ, SEMKIT)	
		A-2	8030-00-602-0049	KT (6 OZ, TWO-PART)	
			8030-00-602-0051	KT (96 OZ, TWO-PART)	
			8030-01-387-1001	OZ (6 OZ, FROZEN)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
101.	(Cont.)	**Class B (Gun or spatula application)**			
		B–1/4	8030–01–214–0374	KT (6 OZ, TWO–PART)	
		B–1/2	8030–00–602–0039	KT (6 OZ, TWO–PART)	
			8030–00–348–7888	KT (12 OZ, TWO–PART)	
			8030–01–381–5291	OZ (2.5 OZ, FROZEN)	
			8030–01–381–5302	OZ (6 OZ, FROZEN)	
			8030–01–252–7963	CA (2.5 OZ, SEMKIT)	
			8030–00–602–0045	CA (6 OZ, SEMKIT)	
		B–2	8030–00–485–3237	KT (12 OZ, TWO–PART)	
			8030–01–066–6444	KT (24 OZ, TWO–PART)	
			8030–00–585–4900	KT (96 OZ, TWO–PART)	
			8030–01–383–4185	OZ (2.5 OZ, FROZEN)	
			8030–01–383–3953	OZ (6 OZ, FROZEN)	
			8030–00–560–8758	CA (2.5 OZ, SEMKIT)	
		B–4	8030–01–195–0655	KT (24 OZ, TWO–PART)	
		B–6	8030–00–602–0035	OZ (6 OZ, FROZEN)	
			8030–01–387–1061	CA (6 OZ, SEMKIT)	
		Class C (Extended assembly time)			
		C–1/2	8030–01–311–5653	KT (24 OZ, TWO–PART)	
102.	Sealing Compound, Low Adhesion, Non–Chromate Corrosion Inhibitive Polysulfide Rubber	P/N: PR–1773, Class B (supersedes PR–1403G) **Class B (Gun or spatula application)**			Two–part, fuel resistant material for sealing access doors and form in place (FIP) gaskets. Can also be used for sealing removable structures, panels, etc., faying surfaces and fastener heads. Cures at room temperature.
		B–1/2	8030–01–418–5414	CA (2.5 OZ, SEMKIT)	
			8030–01–418–5418	CA (6 OZ, SEMKIT)	
		B–2	8030–01–104–5396	KT (24 OZ,TWO–PART)	
			8030–01–418–5415	CA (2.5 OZ, SEMKIT)	
			8030–01–418–5417	CA (6 OZ, SEMKIT)	
103.	Sealing Compound, Low Adhesion, Corrosion Inhibiting, for Removable Panels and Fuel Tank Inspection Plates	AMS 3367 (supersedes MIL–S–8784) **Class A (Brush or dip application)**			Fillet and faying surface sealing of removable structures such as access doors, floor panels and plates, removable panels, and fuel tank inspection plates. Do not use for sealing integral fuel tanks, high temperature areas, or permanent structures.
		A–1/2	8030–00–291–8380	KT (6 OZ, TWO–PART)	
		A–2	8030–00–584–4399	KT (6 OZ, TWO–PART)	
			8030–01–127–8281	KT (12 OZ,TWO–PART)	
			8030–00–152–0062	CA (2.5 OZ, SEMKIT)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
103.	(Cont.)	**Class B (Gun or spatula application)**			
		B-1/2	8030-00-598-2910	KT (6 OZ, TWO-PART)	
			8030-00-881-3933	KT (12 OZ, TWO-PART)	
			8030-01-028-4336	KT (24 OZ, TWO-PART)	
			8030-01-371-3542	OZ (2.5 OZ, FROZEN)	
			8030-01-372-2986	OZ (6 OZ, FROZEN)	
			8030-00-152-0022	CA (2.5 OZ, SEMKIT)	
			8030-01-365-3912	CA (6 OZ, SEMKIT)	
		B-2	8030-00-616-9191	KT (6 OZ, TWO-PART)	
			8030-00-680-2041	KT (12 OZ, TWO-PART)	
			8030-01-371-9247	OZ (2.5 OZ, FROZEN)	
			8030-01-371-9246	OZ (6 OZ, FROZEN)	
			8030-01-383-4993	CA (6 OZ, SEMKIT)	
104.	Firewall Sealing Compound, Aircraft, One-Part Silicone	AMS 3374 (supersedes MIL-S-38249)			Sealing aircraft firewall structures exposed to very high temperatures to prevent the passage of air and vapors. Cures on exposure to air.
		Type 1 (One-Part, High Temperature Silicone)	8030-00-783-8898	KT (6 OZ, TWO-PART)	
			8030-00-723-5345	KT (12 OZ, TWO-PART)	
			8030-01-033-3485	KT (96 OZ, TWO-PART)	
			8030-01-364-7362	OZ (2.5 OZ, FROZEN)	
			8030-01-365-0049	OZ (6 OZ, FROZEN)	
			8030-01-364-7359	CA (2.5 OZ, SEMKIT)	
			8030-00-783-8886	CA (6 OZ, SEMKIT)	
105.	Sealing Compound, Polythioether, Integral Fuel Tanks and General Purpose, Fast Curing at Ambient and Low Temperatures	AMS 3277 (supersedes MIL-S-29574)			Use for repairing fillet and fastener seals on integral fuel tanks and faying surface seals. Material can also be used for overcoating fasteners and sealing seams and joints. Not for use on aircraft windshields and canopies. **NOTE:** Type I compounds require the use of an adhesion promoter (e.g. PR-186) whereas Type II does not.
		Type I (Requires use of an adhesion promoter)			
		Class A (Brush or dip application)			
		A-1/2	8030-01-330-6568	CA (2.5 OZ, SEMKIT)	
			8030-01-330-0730	CA (6 OZ, SEMKIT)	
		A-1	8030-01-330-0735	CA (2.5 OZ, SEMKIT)	
			8030-01-330-3437	CA (6 OZ, SEMKIT)	
		Class B (Gun or spatula application)			
		B-1/4	8030-01-290-5134	CA (2.5 OZ, SEMKIT)	
			8030-01-290-5135	CA (6 OZ, SEMKIT)	
		B-1/2	8030-01-290-5136	CA (2.5 OZ, SEMKIT)	
			8030-01-290-5137	CA (6 OZ, SEMKIT)	
		B-2	8030-01-290-5138	CA (2.5 OZ, SEMKIT)	
			8030-01-290-5139	CA (6 OZ, SEMKIT)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.		National Stock Number	Unit of Issue	Intended Use
105.	(Cont.)	Type II (Does not require the use of an adhesion promoter)				
		Class B (Gun or spatula application)				
		B-1/4		8030-01-364-3883	CA (2.5 OZ, SEMKIT)	
				8030-01-364-3886	CA (6 OZ, SEMKIT)	
		B-1/2		8030-01-364-3882	CA (2.5 OZ, SEMKIT)	
				8030-01-364-3885	CA (6 OZ, SEMKIT)	
		B-2		8030-01-364-3881	CA (2.5 OZ, SEMKIT)	
				8030-01-364-3884	CA (6 OZ, SEMKIT)	
106.	Silicone Adhesive-Sealant, One-Part, Room Temperature Vulcanizing (RTV), Non-fuel Resistant, Non-corrosive (Synthetic rubber)	MIL-A-46146	**Color**			For use on sensitive metals and equipment at temperature less than 400_F (204_C). Cures at room temperature upon contact with moisture in the air. To improve adhesion, use sealant with primer coat (Item No. 107). Kit (KT) includes primer coat, but tube (TU) does not.
		Type I (Paste)	Clear	8040-01-394-3735	TU (3 OZ)	
			White	8040-01-331-7133	TU (3 OZ)	
			White	8040-00-118-2695	KT (3 OZ)	
			Gray	8040-00-145-0020	TU (3 OZ)	
			Red	8040-01-308-4963	TU (3 OZ)	
		Type II (Liquid, self-leveling)	Clear	8040-01-331-7127	TU (3 OZ)	
			Clear	8040-01-441-0671	KT (3 OZ)	
			Gray	8040-01-375-4805	TU (3 OZ)	
		Type III (High strength)	Clear	8040-00-117-8510	TU (3 OZ)	
			White	8040-01-157-9469	TU (3 OZ)	
			Gray	8040-01-450-6545	TU (3 OZ)	
			Gray	8040-01-275-5052	KT (3 OZ)	
			Red	8040-00-902-3871	KT (3 OZ)	
107.	Silicone RTV Primer Coat (for use with Item No. 106)		**Color**			Use for improving adhesion of silicone RTV adhesive-sealants.
		GE SS 4004	Red	8040-00-083-8403	PT	
		DC 1200	Red	8040-00-111-2682	PT	
		DC 1200	Clear	8040-00-845-4304	PT	
			Red	8040-00-870-0877	QT	
			Red	8040-00-914-6970	GL	
108.	Skyflex t Sealing Tape, Polytetrafluoroethylene, expanded (ePTFE), Oil and Water Resistant	AMS 3255				Sealing of faying surfaces, pressurized and non-pressurized access panels, floorboards, and windscreens upon approval from Type, Model, Series (TMS) engineering authority. Do not use in integral fuel tanks, fuel soaked or high temperature applications up to 250_F. Environmentally preferred non-hazardous alternative to two-component, solvent-based sealants.
		Class 1 (Continuous, ribbed)				
		GUA-1001-1		8030-01-367-7357	RO (100 FT)	
		GUA-1001-2		Open Purchase	RO (100 FT)	
		GUA-1003-1		8030-01-368-7207	RO (100 FT)	
		GUA-1017-1		8030-01-368-7208	RO (100 FT)	
		GUA-1401-1		8030-01-454-7419	RO (100 FT)	
		GSC-21-80767-00		8030-01-454-7418	RO (100 FT)	
		GO-DO-0069-1		8030-01-467-6025	RO (100 FT)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
108.	(Cont.)	**Class 2 (Continuous, non-ribbed)**			
		GUA-1038-1	8030-01-463-6459	RO (100 FT)	
		GUA-1057-1	8030-01-377-3084	RO (100 FT)	
		GUA-1058-1	8030-01-381-1584	RO (100 FT)	
		GUA-1059-1	Open Purchase	RO (100 FT)	
		GUA-1301-1	Open Purchase	RO (100 FT)	
109.	Adhesion Promoter for Polysulfide Sealing Compounds, Solvent Based (Blue solution)	AMS 3100 (P/N: PR-148 Titanate Solution)	8030-00-560-8756	PT	Coupling solution for enhancing the adhesion of polysulfide compounds to a wide variety of substrates (e.g. integral fuel tanks). Apply by brush or clean cloth. Material dries at room temp in approx. 30 minutes.
110.	Adhesion Promoter for Polysulfide Sealing Compounds, Water Based (Pink solution)	P/N: PR-182	8030-01-131-3228	PT	VOC compliant coupling solution for enhancing the adhesion of polysulfide compounds to a wide variety substrates. Apply by brush or clean cloth. Material dries at room temp in approx. 30 minutes.
111.	Adhesion Promoter for Polythioether Sealing Compounds, Solvent Based (Yellow solution)	P/N: PR-186 Silane Solution	8030-01-363-6680	OZ (1 OZ)	Coupling solution for enhancing the adhesion of polythioether compounds to manganese cured polysulfide sealants. Apply by brush or clean cloth. Material dries at room temp in approx. 30 minutes.
			8030-01-363-6679	OZ (2 OZ)	
			8030-01-363-6678	PT (16 OZ)	
112.	Plastic Adhesive for ePTFE Skyflex t Sealing Tape with no adhesive backing (Red-brown in color)	Scotch-Grip 847 (Liquid)	8040-01-033-7507	TU (5 OZ)	Use to hold ePTFE sealing tape with no adhesive backing in place. Fast drying and resists weathering, water, oil, plasticizer migration, and aliphatic fuels.
113.	Plastic Adhesive for ePTFE Skyflex t Sealing Tape with no adhesive backing (Amber in color)	MMM-A-189			Use to hold ePTFE sealing tape with no adhesive backing in place. Fast drying and resists weathering, water, oil, plasticizer migration, and aliphatic fuels.
		Scotch-Grip 1099 (Brush)	8040-01-126-1422	QT (32 OZ)	
		Scotch-Grip 1099-L (Spray)	8040-00-043-1717	TU (2 OZ)	
		Solvents			
114.	Dry Cleaning and Degreasing Solvent	A-A-59601 (supersedes P-D-680)			General purpose cleaning solvent for removing oil, grease, preservation compounds, etc. from painted or unpainted metal surfaces. Do not use as a final cleaner prior to painting.
		Type II (High flash point)	6850-00-110-4498	PT (16 OZ)	
			6850-00-637-6135	GL (1 GAL)	
			6850-00-274-5421	CN (5 GAL)	
			6850-00-285-8011	DR (55 GAL)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
114.	(Cont.)	Type III (Very high flash point)	6850–01–377–1916 6850–01–377–1811 6850–01–377–1808 6850–01–377–1809 6850–01–331–3349 6850–01–331–3350	CN (4 OZ) PT (16 OZ) QT (32 OZ) GL (1 GAL) CN (5 GAL) DR (55 GAL)	Ideal for use in localities where Type II of this material is restricted or prohibited.
		Type IV (High flash point with d–limonene)	6850–01–472–2723 6850–01–472–2721 6850–01–472–2722 6850–01–472–2717 6850–01–472–2719	PT (16 OZ) QT (32 OZ) GL (1 GAL) CN (5 GAL) DR (55 GAL)	
115.	Mineral Spirits, Hydrocarbon Dry Cleaning Solvent (P–D–680 alternative)	ASTM D235 Type II, Class C (High flash point)	6850–01–463–7877 6850–01–463–7881	CN (5 GAL) DR (55 GAL)	General purpose cleaning solvent for removing oil, grease, preservation compounds, etc. from painted or unpainted metal surfaces. Ideal for use in localities where MIL–PRF–680, Type II is restricted or prohibited.
116.	Wipe Solvent, Low Vapor Pressure, General Purpose (MEK, MIBK, MIL–T–81772, and Aliphatic Naphtha wipe cleaning alternative)	P–W–2891 Type I (Fast evaporating), Class A (General use, do not use on plastics)	7930–01–436–8085 7930–01–436–8023 7930–01–436–8077 7930–01–436–7959 7930–01–436–8019	PT (16 OZ) QT (32 OZ) GL (1 GAL) CN (5 GAL) DR (55 GAL)	Cleaning of aircraft surfaces prior to painting, sealing, adhesive bonding, etc. Type II, Class B of this spec. is safe to use on windscreens and canopies.
		Type II (High flash point), Class B (Acrylic and polycarbonate compatible)	7930–01–436–8024 7930–01–436–7904 7930–01–436–7953 7930–01–436–7944 7930–01–436–8013	QT (32 OZ) GL (1 GAL) BX (4, 1–gal BTs) CN (5 GAL) DR (55 GAL)	
117.	Wipe Solvent for Aircraft Surfaces, General Purpose (MEK, MIBK, and MIL–T–81772 alternative)	AMS 3166	7930–01–367–0994 7930–01–367–0995 7930–01–367–0996 7930–01–367–0997	BX (24, 1–pt BTs) BX (4, 1–gal BTs) CO (5 GAL) DR (55 GAL)	Cleaning of aircraft structural (i.e., metal and composite) surfaces prior to painting, sealing, bonding, application of adhesion promoters, etc.

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
118.	Paint Spray Gun and Pre-paint Wipe Cleaner (MIL-T-81772 alternative)	TT-T-2935	8010-01-474-7092 8010-01-474-7097 8010-01-474-8982 8010-01-474-7098 8010-01-474-7095	PT QT GL CN (5 GAL) DR (55 GAL)	Cleaning of paint spray guns and aircraft surfaces prior to painting and sealing in lieu of MIL-T-81772. Do not use to clean polycarbonate or acrylic materials, and not intended for thinning/reducing paints.
119.	Isopropyl Alcohol (i.e., IPA, 2-Propanol, and Isopropanol)	TT-I-735 Grade A (Technical)	6810-00-753-4993 6810-00-983-8551 6810-00-286-5435 6810-00-543-7915	CN (8 OZ) QT (32 OZ) GL (1 GAL) DR (55 GAL)	Use for removing fungi (molds), preparing surface prior to painting, sealing, etc. Do not use on acrylic plastic materials.
		ACS Grade (Reagent)	6810-00-183-4393 6810-00-822-7637 6810-00-227-0410 6810-01-448-9253 6810-00-586-6647 6810-00-944-9657	PT (16 OZ) QT (32 OZ) GL (1 GAL) BT (4 LITERS) CN (5 GAL) DR (55 GAL)	
120.	Aliphatic Naphtha	TT-N-95, Type II	6810-00-238-8119 6810-00-265-0664 6810-00-238-8117	GL (1 GAL) CN (5 GAL) DR (55 GAL)	Use for cleaning/degreasing acrylic plastics (i.e., windscreens and canopies).
121.	Acetone (i.e., 2-Propanone and Dimethylketone), 99.5% grade	ASTM D329 (supersedes O-A-51)	6810-00-223-2739 6810-01-003-0262 6810-00-184-4796 6810-00-281-1864	PT (16 OZ) GL CN (5 GAL) DR (54 GAL)	General purpose wipe cleaning solvent for removing light oils, greases, preservation compounds, etc. from painted or unpainted metal and composite surfaces.
122.	Solvent Cleaning Compound for Integral Fuel Tank	A-A-59281 (supersedes MIL-C-38736) Type I (Normal solvent blend)	6850-00-611-7993 6850-00-538-0929 6850-01-016-3482	PT (16 OZ) GL (1 GAL) DR (55 GAL)	Wipe cleaning of aluminum surfaces and solvent resistant coatings prior to chemical treatments or the application of integral fuel tank sealants.
		Type II (Non-photochemically reactive solvent blend)	6850-01-383-2171 6850-01-383-2117 6850-01-383-2377 6850-01-383-2103	PT (16 OZ) GL (1 GAL) CN (5 GAL) DR (55 GAL)	

Appendix A. Consumable Materials (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
Tags/Forms					
123.	Water/Crash/Fire Damage Tag (Navy uses ONLY)	NAVAIR 3750/1 (Rev. 10/98)	0102–LF–994–3300	PG (50)	Use for tagging equipment or parts removed from aircraft involved in water, crash, and/or fire damage.
124.	Water/Crash/Fire Damage Label (Navy uses ONLY)	NAVAIR 4035/13 (Rev. 6/98)	0102–LF–994–2800	PG (50)	Use for tagging equipment or parts removed from aircraft involved in water, crash, and/or fire damage.

APPENDIX B

ACCESSORIES FOR CORROSION CONTROL

B-1. INTRODUCTION.

NOTE

The materials referenced in this appendix are approved for use, but approval should not be misconstrued as an endorsement of any manufacturer's product(s). If an equivalent for an application/procedure is not referenced herein, contact your service representative for approval: Naval Aviation Depot North Island (Code 434), the Air Force Corrosion Program Office, or the U.S. Army Aviation Systems Command.

B-2. Appendix B provides accessories used for aircraft cleaning and corrosion control. The column headings list nomenclatures, specifications/part numbers, national stock numbers (NSNs), units of issue (U/I), and intended uses. Items are located by function in the following groupings:

Cleaning accessories
Corrosion removal accessories
Conversion coating accessories
Painting accessories
Safety accessories
Sealing accessories

B-3. Air Force units should refer to Table of Allowance 480 and Section X of Appendix E for additional authorization of equipment.

B-4. The unit of issue abbreviations are shown and explained as follows:

CODE	UNIT	CODE	UNIT	CODE	UNIT
BG	Bag	DZ	Dozen	OZ	Ounces
BO	Bolt	EA	Each	PG	Package
BT	Bottle	FT	Foot	PR	Pair
BX	Box	GL	Gallon	PT	Pint
CA	Cartridge	GR	Gross	QT	Quart
CB	Carboy	JR	Jar	RO	Roll
CN	Can	KT	Kit	SE	Set
CO	Container	LB	Pound	SH	Sheet
CS	Case	LG	Length	TU	Tube
DR	Drum	MX	Thousand	YD	Yard

Appendix B. Accessories for Corrosion Control

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
1.	Aircraft Washing Kit, Exterior, Conformable	3M No. 251M	7920-00-490-6046	KT	General cleaning of aircraft surfaces.
2.	Cleaning and Scouring Pad, Non-metallic (for aircraft)	A-A-3100 (supersedes MIL-C-83957) Type I (3/8" thick) Type II (1" thick)	 7920-00-151-6120 7920-00-171-1534	 PG (10) PG (10)	Replacement sponge (12" L x 6" W) for washing kit No. 251M. Hand held or attach to the wash applicator.
3.	Scrub Brush, Aircraft Cleaning (Tampico Fiber material)	A-A-2074 (supersedes H-B-1490) (10-3/4" L x 2-3/4" W)	7920-00-282-2470	EA	Application of cleaner and scrubbing of aircraft surfaces.
4.	Window Brush, Waterproof (Horsehair material)	A-A-3080 (supersedes MIL-B-23958) Type I - Round shape 4.5" dia. 5" dia. 8" dia Type II - Rectangular shape 6" L x 4" W	 7920-00-240-7176 7920-00-051-4384 7920-00-297-1509 7920-01-136-8892	 EA EA EA EA	Scrubbing painted aircraft surfaces and windows.
5.	Toothbrush, Soft Bristle, Straight Line Design	A-A-59 (Children's) A-A-123 (Adult's)	8530-01-293-1388 8530-01-293-1387	DZ (30) DZ (30)	Cleaning intricate parts. Before using, insure chemicals will not dissolve or soften brush.
6.	Handle, Wood, Threaded and Tapered Ends (for use with Item No. 3)	A-A-3082 (supersedes NN-H-104) Type I - Threaded metal end 7/8" dia. x 4' L Type II – Tapered end 15/16" dia. x 4.5' L 15/16" dia. x 5' L 1-1/8" dia. x 4.5' L 1-1/8" dia. x 8' L	 7920-00-982-6512 7920-00-177-5106 7920-00-283-0328 7920-00-141-5452 7920-00-263-0327	 EA EA EA EA EA	Handle for brushes.
7.	Handle, Aluminum, 2-piece Threaded End with 7/8" dia. (for use with Item No. 3)	A-A-1464	7920-00-926-5146	EA	Extension for scrub brush to clean, paint, or wash high surfaces. Extendable from 5' to 10'.

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
8.	Water Nozzle, Adjustable	A–A–50461 Garden Hose (Brass) High Pressure (Pistol Grip)	 4730–00–223–6731 4730–00–900–0733	 EA EA	Spraying and rinsing of aircraft.
9.	Water Hose Assembly, Rubber	A–A–59270 (supersedes L–H–520) 5/8" ID x 50' L 3/4" ID x 50' L	 4720–00–203–3920 4720–00–203–3912	 EA EA	Washing and rinsing aircraft.
10.	Pump, Backpack (5 gals. in size)	P/N: 5100–254B	4320–00–289–8912	EA	Localized cleaning and rinsing of aircraft surfaces.
11.	Spray Gun, Pneumatic	MIL–G–952, Type I	4940–00–248–0866	EA	Spraying cleaning compounds. Not for use with solvents.
12.	Cleaning Unit, Portable, Foam Generating Stainless Steel Tank (Porta–Foamer)	Tank capacity: 15 gallons 45 gallons	 4940–01–058–5267 4940–01–041–5680	 EA EA	Foam applicator for MIL–PRF–85570 cleaning compounds. Use with compressed air to spray water detergent or cleaning solvents for cleaning aircraft exteriors, engines, etc. Cleaning gun/sprayer included.
13.	Wash Unit, Universal	P/N: 21C2438G01 (Mfr.: General Electric)	4940–01–185–6215	EA	
14.	Corrosion Control Cart for Jet Engine Cleaning	Model 62555 (P/N: 65A102J1)	4920–00–930–1801	EA	Portable cleaning machine for cleaning and rinsing aircraft turbine engines (Appendix C).
15.	Deicer, Aircraft	Model 58323 (P/N: D40–D)	1730–01–093–6517	EA	Truck mounted spray unit used to provide deicing, anti–icing, and fluid spraying capabilities.
16.	Electric Heater Gun	A–A–59435 Type I (350 – 500_F) Type II (500 – 750_F) Type III (750 – 1000_F)	 4940–00–357–1369 4940–01–028–7493 4940–01–391–7046	 EA EA EA	To thaw or dry equipment/components or to shrink insulating tubing associated with electrical applications.
17.	Mini–Vacuum Cleaner, Pneumatic, Venturi–type (made of aluminum)	P/N: AT560	5130–01–368–5861	EA	Removing dirt and debris.

Appendix B. Accessories for Corrosion Control (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
18.	Vacuum Cleaner with attachments	Pneumatic Electric (A-A-54943)	7910-00-807-3704 7910-01-236-0893	EA EA	Removing dirt and debris.
19.	Bottle, Adjustable, Sprayer Nozzle (16 oz. in size)	A-A-2806	8125-00-488-7952	EA	Spraying of cleaning compounds.
20.	Spray Kit, Self Pressurized Plastic Bottle (32 oz. in size)	P/N: 4382T1	4940-01-364-8761	EA	Spraying of dilute cleaning compounds.
21.	Utility Pail, Rubber (3 gals. in size)	L-P-65	7240-00-246-1097	EA	Container for holding materials.
		Conversion Coating Accessories			
22.	Acid Swabbing Brush, Metal Handle (Horsehair bristle)	A-A-289 (5-3/4" L x 3/8" W)	7920-00-514-2417	GR	Disposable brush for applying chemical conversion coatings, touching up paints, etc.
23.	Sponge Stick Moistener	A-A-137 (supersedes GG-M-571)	7520-00-241-2981	EA	Application of chemical conversion coating materials.
24.	Wash Bottle, Plastic (250 ml. in size)		6640-00-299-8493	EA	Use for rinsing chemically treated surfaces.
		Conversion Removal Accessories			
25.	Air Drill Motor with ¼" Chuck (3200 rpm)	OO-D-691	5130-00-294-9511	EA	Scuff sanding and corrosion removal.
26.	Drill Chuck Key, ¼" (for use with Item No. 25)	A-A-50966	3460-00-264-5577	EA	Securing or releasing drill bit. For use with above drill motor.
27.	Oscillating Pad Sander, Pneumatic, Orbital Motion (6,000-9,000 rpm)	A-A-2687 (supersedes OO-S-101)	5130-00-606-9694	EA	Scuff sanding and corrosion removal. Also used for finish sanding, feather edging, and blending of paint systems.

Appendix B. Accessories for Corrosion Control (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
28.	Disc Sander, Pneumatic, Random Orbital, Dual Motion Vertical Drive with 6” dia. sanding pad (8,000–12,000 rpm)	A–A–2690 (supersedes OO–S–101)	5130–00–204–0623	EA	Scuff sanding and corrosion removal. Also used for blending, smoothing, and feathering edges. The sander’s random orbital action prevents scratches and swirl marks.
29.	Dry Honing Machine, Portable, Air–Operated	P/N: 41303 (Mfr.: Vacu–Blast Corp.)	4940–00–872–1712	EA	A compact, self–contained, and light–weight unit used for the safe and convenient removal of corrosion products from aircraft and its components.
30.	Electrical Pump Kit for Honing Machine (for use with Item No. 29)	P/N: 918708 (Mfr.: Vacu–Blast Corp.)	4940–00–948–3810	EA	The electric pump allows the Honing Machine to use low pressure/low volume air to operate instead of the low pressure/high volume air required to operate units equipped with the air ejector pump.
31.	Air Nozzle Gun	A–A–55543 (supersedes GGG–G–770)	4940–00–223–8972	EA	Use to remove chips, dirt, and waste material from machines, work pieces, or benches.
32.	Air Hose Assembly, General Purpose	ZZ–H–521 3/8” ID x 50’	 4720–00–289–3429	 FT	Use for painting and vacu–blasting.
		ZZ–H–500 5/8” ID x 50’ 3/4” ID x 50’	 4720–00–278–4890 4720–00–278–4891	 FT FT	

Appendix B. Accessories for Corrosion Control (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
33.	Coupling Half, Air Hose, Low Pressure, Quick Disconnect	MIL-C-4109 Male quick disconnect			
		1/4” NPT/M	4730-00-494-3271	EA	Male quick disconnect half for use with pneumatic tools and paint spray guns.
		3/8” NPT/M	4730-00-293-7182	EA	
		3/8” Hose Shank/M	4730-00-277-5679	EA	
		1/2” NPT/M	4730-00-293-7165	EA	Male quick disconnect half for use with portable dry honing machines.
		1/2” Hose Shank/M	4730-00-905-9794	EA	
		3/4” NPT/M	4730-00-293-7043	EA	
		Female quick disconnect			
		1/4” NPT/F	4730-01-177-0987	EA	Female quick disconnect half for use with pneumatic tools and paint spray guns.
		3/8” NPT/F	4730-00-203-0178	EA	
		3/8” Hose Shank/F	4730-00-494-3272	EA	
		1/2” NPT/F	4730-00-293-7165	EA	Female quick disconnect half for use with portable dry honing machines.
		1/2” Hose Shank/F	4730-00-701-0228	EA	
		3/4” NPT/F	4730-00-442-5738	EA	
34.	Hose Clamp	A-A-52506 (supersedes WW-C-440)	4730-00-826-4268	EA	Metal hose clamps used for holding flexible ducts or hose on to a male fitting.
35.	Hand Pad Holder (for use with Item No. 1, App. A)	3M No. 952 (INSTA-LOK)	Open Purchase	EA	Hand tool for holding abrasive pads.
36.	Disk Pad Holder, Hook and Loop (for use with Item No. 41)	3M No. 9215 (1.5” dia. x ¼” shank)	Open Purchase	EA	Back-up pad to run surface conditioning discs. Use with a drill.
		3M No. 923 (3” dia. x ¼” shank)	5345-01-342-5932	EA	
37.	Disc Sander Pad (for use with Item No. 5, App. A)	3M No. 051144–05576	5130-01-075-8137	EA	Back-up pad to run 6” dia. abrasive paper discs. Use with a dual motion sander.
38.	Mandrel (for use with Item No. 39)	3M No. 933, 1” washer (2” length x ¼” shank)	3460-01-044-2626	EA	Use with 2” - 3” dia. discs.
		3M No. 934, 2½” washer (3-1/16” length x ¼” shank)	3460-00-150-7164	EA	Use with 3” - 6” dia. discs.
		3M No. 935, Mini Mandrel (2-7/8” length x ¼” shank)	3460-00-150-7163	EA	Use with 1” x 1.5” pieces of abrasive material to fit into tight areas.

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
39.	Finishing Flap Brush, Aluminum Oxide, Non-woven, Maroon in color (6” D x 1” W x 2” arbor hole)	3M No. 5AFIN (fine grit) 3M No. 5AMED (med. grit)	5345-00-151-7936 5345-00-157-9790	EA EA	Removing mild corrosion and polishing surfaces. Also for mechanical removal and feathering of paint systems. ONLY for use with a bench motor.
40.	Stackable Deburring Disc, High Strength, Aluminum Oxide, Non-woven Nylon, Maroon in color (6” D x ½” arbor hole)	3M No. 048011–04188 (medium grit) 3M No. 048011–00665 (very fine grit)	Open Purchase Open Purchase	EA EA	Removing mild corrosion and polishing surfaces. Also for mechanical removal and feathering of paint systems. Use with a drill and a No. 934 Mandrel.
41.	Surface Condition Discs, Aluminum Oxide (for use with Item No. 36)	Very Fine grit (Blue in color) 3M No. 048011-04T756 (1.5” dia.) 3M No. 048011-04T770 (3” dia.) Medium grit (Maroon in color) 3M No. 048011-041223 (1.5” dia.) 3M No. 048011-041247 (3” dia.)	 Open Purchase Open Purchase Open Purchase Open Purchase	 EA EA EA EA	Corrosion removal and surface preparation. The discs have minimal metal/substrate removal.
42.	COMBI-S Wheel with Spindle Mount, Aluminum Oxide, Maroon in color (3” D x 1¾” W x ¼” shank)	120 grit (3M No. 051144-80678) 180 grit (3M No. 051144-80799)	 Open Purchase Open Purchase	 EA EA	Combination of aluminum oxide coated abrasive and non-woven nylon material used for finishing, blending, and removing light to medium corrosion. Maximum operating speed (MOS) is 8000 RPM.
43.	Flap Wheel, Abrasive, Aluminum Oxide	MIL–W–81319, Type I 150 grit (3” D x ¾” W x ¼” shank) 280 grit (2” D x ½” W x ¼” shank) 320 grit (3M No. 051144-96837) (3” D x 1” W x ¼” shank)	 5345-00-732-9989 5345-00-935-7869 Open Purchase	 EA EA EA	Removing medium to severe corrosion (e.g. intergranular, exfoliation) from thick materials. The wheels will remove metal/substrate.
44.	Abrasive Disk Kit for Composite Material Repair		5345-01-015-1419	KT	For use on composite and honeycomb materials ONLY. Comes with 3 disc holders and 150 discs of assorted grits in 1”, 2”, and 3” sizes (50 each).

Appendix B. Accessories for Corrosion Control (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
45.	Rotary File, Tungsten Carbide (Fine Fluted)	A-A-51176 Cone shape Cylindrical shape 1/4” dia. x 3/4’ L 1/4” dia. x 1’ L	 3455-00-293-3560 3455-00-293-3559 3455-00-293-3561	 EA EA EA	Removing corrosion and underlying metal; attach to a pneumatic drill. **NOTE:** ONLY authorized for use at Depot level maintenance activities.
46.	Stripe Off Wheel with 3/8” Mandrel, Non-abrasive	3M No. 051131-07498 (4” D x 5/8” W x 3/8” shank)	Open Purchase	CS (5)	Use for removing adhesives, sealants, vinyl stripping tapes, decals, graphics, double-sided molding tapes, and leading edge tapes without removing/ damaging the under-coatings. Use with an air drill motor. Recommended operating speed is 2500 RPM. **NOTE:** Do not use on acrylic lacquer paints, or polycarbonate and acrylic plastics (canopies and windscreens).
47.	Optical Micrometer Kit	P/N: 966A1	6650-00-831-5532	EA	Inspection of corrosion.
48.	Depth Gage, Needle Point Dial Indicator	P/N: 6527281	5210-00-710-4359	EA	Precision measurement of corrosion damage with range of 0.0 to 0.125 inches.
49.	Magnifying Glass, Folding Pocket Type (Circular shape)	GG-M-95, Type III, Class C Triple lens	 6650-00-530-1880	 EA	Inspection of corrosion. Magnifying power of the lenses are 5X, 7X, and 10X. Lens pivot for single or combination use.
50.	Inspection Mirror, Spring Loaded, Plunger Actuated (Rectangular shape)	GGG-M-350, Type II, Class 3 Small (1.5” L x 1.25” W) Large (2.625” L x 1.750” W)	 5120-00-278-9926 5120-00-618-6902	 EA EA	Aid for inspecting hard to see corrosion areas.
51.	Marking Pencil, Non-corrosive (7” in length)	MIL-P-83953 Yellow in color Red in color	 7510-00-537-6930 7510-00-537-6935	 DZ DZ	Identification of corroded areas.
52.	Plater’s Hand Brush, Curved Handle Style	A-A-3118 (supersedes H-B-178) Type I, Class 2	 7920-00-244-7431	 EA	Removing corrosion products, paint film, and application of cleaning solvents.
53.	Hand Brush, Wooden Handle, Stainless Steel Fill	P/N: 15SS	7920-00-900-3577	EA	Removing corrosion products from aluminum.

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
54.	Flashlight, Metal	A–A–1382	6230–01–247–7549	EA	Use for corrosion inspection.
55.	Flashlight, Metal (Rechargeable)	A–A–1382	6230–01–152–5952	EA	Use for corrosion inspection.
56.	Scissors	GGG–S–278 Shears (9” in length) Electricians’ (5–1/4” in length)	 5110–00–161–6912 5110–01–336–5726	 EA EA	Cutting tapes, cheese–cloth, masking materials, electrical wires, etc.
		Painting Accessories			
57.	Paint Spray Gun, High Volume Low Pressure (HVLP)	JGHV–531–46FF (Mfr.: DeVilbiss) DT–200 DeTach II (Mfr.: AirVerter) Mach 1 (Mfr.: Binks) Mach 1 Outfit 98–1141 (Mfr.: Binks)	4940–01–315–8352 4940–01–457–1936 4940–01–345–2132 4940–01–445–9961	EA EA EA EA	Paint gun only. Paint gun with 1 qt. cup and air control. Paint gun only. Paint gun with 1 qt. cup with regulator.
58.	Repair Kit for HVLP Paint Spray Gun	KK–4987–2 DT–225 (Bench Parts Kit) DT–227 (Hi–Wear Maintenance Kit) 54–3605 (Gun Repair Kit)	4940–01–046–9919 4940–01–457–4530 4940–01–457–4056 4005–01–454–7667	KT KT KT KT	For DeVilbiss’ JGHV paint gun. For AirVerter’s DT–200 paint gun. For AirVerter’s DT–200 paint gun. For Binks’ Mach 1 paint gun.
59.	Touchup Paint Spray Gun, HVLP	Suction/Pressure feed: EGHV–605 (Mfr.: DeVilbiss) PT–100AC ProTouch (Mfr.: AirVerter) Mach 1 Cub (Mfr.: Binks) Gravity feed: TGHV–635 (Mfr.: DeVilbiss) CT–100 Stencil Pro (Mfr.: AirVerter) M1–G (Mfr.: Binks)	 4940–01–346–2236 4940–01–467–7132 Open Purchase Open Purchase 4940–01–439–7460 4940–01–432–9513	 EA EA EA EA EA EA	 Touchup gun with 8 oz. poly cup. Detail gun with 8 oz. cup and air control. Touchup gun only. Touchup gun with 8 oz. Aluminum cup. Detail gun with 8 oz. poly cup. Touchup gun only.
60.	Repair Kit for HVLP Touchup Paint Spray Gun	KK–5044 PT–025 (Bench Stock Parts Kit) PT–027 (Hi–Wear Maintenance Kit) CT–11 (Hi–Wear Maintenance Kit) 54–4367 (Gun Repair Kit)	4940–01–182–6975 4940–01–439–7946 4940–01–439–7948 4940–01–439–7966 Open Purchase	KT KT KT KT KT	For DeVilbiss’ EGHV paint gun. For AirVerter’s PT–100 paint gun. For AirVerter’s PT–100 paint gun. For AirVerter’s CT–100 paint gun. For Binks’ M1–G paint gun.

Appendix B. Accessories for Corrosion Control (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
61.	Replacement Cups for HVLP Spray and Touchup Guns	TGS-503 (8 oz.)	4940-00-222-2675	EA	Poly suction feed cup.
		PT-24 (8 oz.)	4940-01-395-8844	EA	Poly pressure feed cup assembly.
		TLC-576 (1 qt.)	4940-00-190-5164	EA	Aluminum pressure feed cup.
		KB-555 (2 qt.)	4940-01-106-1415	EA	Aluminum pressure feed remote cup.
62.	Nozzles for HVLP Spray and Touchup Guns (for use with AirVerter paint spray and touchup guns)	MF-100-6 (DT-200 paint gun with 6” flexible end)	4940-01-457-3497	EA	Spraying hard to reach areas. Comes in fan or round spray pattern.
		SN-126-12 (12” fixed extension without paint gun)	4940-01-457-3380	EA	Extension with rotating head. Comes in fan or round spray pattern.
63.	Hose Set and Assemblies for HVLP Pressure Feed Spray and Touchup Guns (all hose assemblies come with fittings)	KB-4004, 4’ hose (air and fluid set)	Open Purchase	SE	For remote cup usage.
		KB-4006, 6’ hose (air and fluid set)	Open Purchase	SE	For remote cup usage.
		AV-014-25, 3/8” I.D. x 25’ (air hose assembly)	4720-01-457-4177	EA	Supply compressed air to the paint gun.
		AV-016-25, 3/8” I.D. x 25’ (fluid hose assembly)	4720-01-457-4186	EA	For remote pressure tank usage.
		AV-014-50, 3/8” I.D. x 50’ (air hose assembly)	4720-01-457-4173	EA	Supply compressed air to the paint gun.
		AV-016-50, 3/8” I.D. x 50’ (fluid hose assembly)	4720-01-457-4187	EA	For remote pressure tank usage.
64.	Metering Valve for HVLP Pressure Feed Spray Guns	HAV-500G	4820-00-410-8609	EA	Air pressure valve/regulator for both DeVilbiss and AirVerter paint spray and touchup guns.
65.	Compressed Air Separator (air regulator assembly)	MIL-S-12928			Wall-mounted separators designed to remove oil, water, and foreign particles from compressed air and to regulate the delivery pressure of air used for spraying paint and pneumatic tools.
		Class 1 (1 regulator, 2 outlets)	4940-00-242-4100	EA	
		Class 2 (2 regulators, 4 outlets)	4940-00-242-4101	EA	
66.	Paint Brush, Flat, Metal Bound, Synthetic Fiber	H–B–420, Type II			Paint touchup.
		1” wide	8020-00-263-3866	EA	
		2” wide	8020-00-550-8359	EA	
67.	Artist Brush (3/8” in size)	H-B-118	8020-00-597-4767	EA	Use of applying lacquer.
68.	Artist Airbrush Kit (3 fl. oz. in size)	A-A-1533	7520-00-939-6179	EA	Spraying applicator for paints, preservatives, and other touching up materials.

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
69.	Color Fandeck	FED-STD-595	7690-01-162-2210	EA	A collection of standard colors used by the federal government to identify paints, coatings, etc.
70.	Stencil Marking Set, Gothic Style (made of Brass)	A-A-130 (supersedes RR-S-714)			Reusable aircraft marking. Each set includes 1 ampersand, 1 apostrophe, 1 comma, 3 end pieces, 1 period, 2 spacers, 1 set of letters A thru Z, and 1 set of numerals “0” thru “9”.
		1/2” size marking	7520-00-205-1760	SE	
		1”	7520-00-298-7043	SE	
		1-1/2”	7520-00-272-9680	SE	
		2”	7520-00-298-7044	SE	
		3”	7520-00-272-9683	SE	
		4”	7520-00-269-9012	SE	
		5”	7520-00-272-9684	SE	
71.	Stencilboard (100 sheets)	A-A-1733			Preparation of stencils for painting.
		(36” L x 24” W x 0.0165” thick)	9310-00-160-7858	PG	
72.	Paint Mixer, Revolving Shaft and Agitator Types (electric motor driven)	A-A-59433 (supersedes MIL-M-3070)			Blends paints or oils by agitation.
		Type I - Revolving Shaft Mixer			
		Class 1 - 1/2 hp (115V)	4940-00-221-1707	EA	
		Type II - Agitator Type Mixer			
		1/4 hp (115V)	4940-00-243-2735	EA	¼ Pint to 1 gallon mixer.
		1/3 hp (110V)	4940-00-243-2736	EA	1 to 5 gallon mixer.
		1/3 hp (115V)	4940-00-251-6475	EA	1 to 5 gallon mixer.
		1/3 hp (220V)	4940-00-254-8666	EA	1 to 5 gallon mixer.
73.	Spray Unit, Self Pressurized	MIL-S-22805			Use for applying paints, degreasing compounds, preservatives, and other touchup materials.
		Model 8011 Power Pak	4940-00-803-6444	KT	
74.	Washer System, Paint Spray Gun (5 gals. in size)	Pro Wash (P/N: 112-636)	4940-01-420-5569	EA	Cleaning of spray guns, hose, pots, and other painting equipment. Compatible for use with both solvent-based and water-based coatings.
		Accessories			Gun and pot/paint can cleaning kits are needed accessories to work with the Pro Wash unit. The kits are sold separately through Graco Inc.
		HVLP Gun Kit (P/N: 236-905)	Open Purchase	KT	
		Pot/Paint Can Kit (P/N: 236-906)	Open Purchase	KT	

Appendix B. Accessories for Corrosion Control (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
75.	Gun Wrench	WR-103	5120-00-422-8932	EA	For adjusting DeVilbiss spray guns.
76.	Viscosity Cups (Stainless steel)	ANSI/NCSL Z540-1 Zahn S90 #2 (P/N: VI-2102) No. 2 EZ Cup (P/N: VI-EZ2)	 6630-01-341-4571 6630-01-412-4906	 EA EA	Adjusting viscosity of paints and sealants before applying.
77.	Wet Film Thickness Gauge, Paint (Comb type)	P/N: WF-CCD (Mfr.: Paul N. Gardner)	Open Purchase	EA	Measuring thickness of wet coatings.
78.	Psychrometer	A-A-2579 Pocket Sling Psychro-Dyne	 6685-00-826-1662 6685-01-263-8370	 EA EA	 Measurement of relative humidity. Measurement of humidity and dew point.
79.	Strainers, Paint Spray Gun	<u>Disposable Strainer</u> Medium mesh (6” in dia.) <u>Gun Mounted Strainer</u> P/N: VS-531 <u>In-Line Strainer</u> P/N: VS-534	 5120-00-541-2028 4940-00-497-0452 Open Purchase	 PG (250) EA EA	Straining paint prior to spraying.
80.	Paint Sprayer’s Sock, One size fits all (made of cotton)	P/N: SS-6 Knit Sock (Mfr.: Reaves and Co.)	8020-01-348-1315	PG (12)	Protects head and neck from paint overspray.
81.	Paint Sprayer’s Hood, Disposable plastic (Blue in color)		4210-01-031-1094	BX (100)	Protects head and neck from paint overspray.
	Safety Accessories (see Figures B-1 thru B-3 at the end of this appendix for illustration of some items in this section.) **NOTE** Consult local Safety Office for Personal Protective Equipment (PPE) requirements. The local Safety Office has authority to substitute equivalent safety accessories when appropriate.				
82.	Particulate Respirator (Mask), Disposable	3M No. 8511	4240-01-247-2348	BX (80)	Protection from inhalation of particulates during light sanding and grinding operations.

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
83.	Full Facepiece Respirator, Air Filtering (w/o cartridges)	3M No. 7800S (Small) 3M No. 7800S (Medium) 3M No. 7800S (Large)	4240–01–314–2780 4240–01–342–5239 4240–01–301–3200	EA EA EA	Personnel protection from organic vapors, dust, and paint sprays in nonconfined areas during spraying operations.
84.	Full Facepiece Respirator, Air Filtering (w/o cartridges)	3M No. 6700 (Small) 3M No. 6800 (Medium) 3M No. 6900 (Large)	4240–01–454–8531 4240–01–454–8535 4240–01–454–8538	BX (4) BX (4) BX (4)	Personnel protection from organic vapors, dust, and paint sprays in nonconfined areas during spraying operations.
85.	Half Facepiece Respirator, Air Filtering (w/o cartridges)	3M No. 6100 (Small) 3M No. 6200 (Medium) 3M No. 6300 (Large)	4240–01–342–2852 4240–01–342–2853 4240–01–342–2854	BX (24) BX (24) BX (24)	Personnel protection from organic vapors, dust, and paint sprays in nonconfined areas during spraying operations.
86.	Filter Cartridges	3M No. 60921	4240–01–455–7353	BX (60)	For use with 3M's half and full facepiece respirators.
87.	Respirator Lens for 3M Full Facepiece Respirators (plastic film)	3M No. 7884 3M No. 6898	4240–01–247–8929 Open Purchase	BX (5) BX (5)	Replacement lens for the 7800S series respirators. Replacement lens for the 6000 series respirators.
88.	Lens Covers, Peel–away for 3M Full Face Respirators	3M No. 7899–25 3M No. 7899–100 3M No. 6885–100	4240–01–248–4634 4240–01–248–6435 4240–01–455–2787	BX (25) BX (100) BX (100)	For 7800S series respirators. For 7800S series respirators. For 6800 series respirators.
89.	Inhalation Valve for 3M Full Facepiece Respirators	3M No. 7282 3M No. 6894	4240–01–248–2607 4240–01–455–2811	BX (200) BX (200)	For 7800S series respirators. For 6800 series respirators.
90.	Exhalation Valve for 3M Full Facepiece Respirators	3M No. 7283 3M No. 6889	4240–01–248–2608 4240–01–455–2809	BX (50) BX (10)	For 7800S series respirators. For 6800 series respirators.
91.	Tyvek Shroud for 3M Full Facepiece Respirators	3M No. 7915–5	4240–01–320–1957	PG (5)	Protects head and neck from paint overspray.

Appendix B. Accessories for Corrosion Control (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
92.	Spectacle Kit for 3M Full Facepiece Respirators	3M No. 6878	4240-01-455-2346	EA	Consists of frame and retainer clip. Use on 6000 Series Facepiece.
		3M No. 7925	4240-01-395-4128	EA	For use with prescription lenses. Use on 7800S Series Facepiece.
93.	Respirator Cleaning Wipes (alcohol-free towelettes)	3M No. 504	Open Purchase	BX (500)	Hygienic cleaning of respirators and other personal protective gear/equipment.
94.	Air Breathing Pump, Pneumatic Driven, Portable	NF-1100 (supersedes NF15-3) (Mfr.: RhineAir)	4240-01-363-4699	EA	Supply air to hoods and facepiece respirators. **NOTE:** Use VV-L-800 (NSN: 9150-00-273-2389) or 10 wt. oil equivalent (MIL-H-17672) to fill in-line oiler of air motor after each use, as required, to maintain lubrication and prevent motor oxidation.
		ADP-16 (Mfr.: Bullard)	4310-01-168-7302	EA	
	WARNING Do not use shop air for breathing. It contains oil, particulates, and harmful gases. Read and follow equipment instructions to determine the maximum number of air lines to be used with a single pump.				
95.	Replacement Filter Cartridges for Breathing Pumps	CF8080 (Mfr.: RhineAir)	4240-01-084-0921	BX (10)	For use with RhineAir's NF-1100 and NF15-3 pumps.
96.	Inlet Compressed Air Hose Assembly, ½" ID Hose w/ 3/8" ID Orifice Fittings	ED1313B-50 (50 ft.) ED1313B-100 (100 ft.)	4240-01-251-8159 4240-01-251-8160	EA EA	Only use for supplying compressed air to air motor on breathing unit. These inlet hose assemblies can be used with both RhineAir and Bullard units.
97.	Replacement Inlet Hose, Quick Disconnect Fittings	3L25 (Male Plug) 3R25 (Female Coupler)	4730-01-442-1809 4730-01-442-1808	EA EA	Replacement fittings for the ED1313B inlet air hose assembly.
98.	Outlet Manifold, Quick Disconnect (Female Coupler Assembly)	ED-06-430 (Mfr.: RhineAir)	Open Purchase	EA	Connects respirator air hose assembly to breathing pump. Can be used with both RhineAir and Bullard units.
99.	Glove, Cotton (Natural in color)	A-A-1665 Large	 8415-00-268-8330	 PR	General purpose protective wear for hands.

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
100.	Gloves, Cloth, Vinyl Dipped, Chemical and Oil Protective (Black in color)	A–A–50370 (supersedes MIL–G–82253)			General purpose protective wear for hands. Rubberized for better grip.
		Medium	8415–00–916–2817	PR	
		Large	8415–00–916–2818	PR	
		Universal (one–size)	8415–00–935–2833	PR	
101.	Gloves, Rubber, Industrial (Black in color)	MIL–G–12223			Heavy duty protective wear for hands while handling solvents, chemical paint removers, paints, sealants, or other materials which may be injurious to the skin. Gloves are not designed for electrical or chemical warfare activities.
		X–Small (Size 8)	8415–00–753–6550	PR	
		Small (Size 9)	8415–00–753–6551	PR	
		Medium (Size 10)	8415–00–753–6552	PR	
		Large (Size 11)	8415–00–753–6553	PR	
		X–Large (Size 12)	8415–00–753–6554	PR	
102.	Gloves, Chemical and Oil Protective, Abrasion Resistant (Green in color)	MIL–G–87066			Protective wear for hands during aircraft detergent wash operations.
		X–Small (Size 7)	8415–01–147–6263	PR	
		Small (Size 8)	8415–01–147–9540	PR	
		Medium (Size 9)	8415–01–012–9294	PR	
		Large (Size 10)	8415–01–013–7382	PR	
		X–Large (Size 11)	8415–01–013–7384	PR	
103.	Gloves, Disposable, Nitrile Rubber, Pre–Powdered, Ambidextrous (Light blue in color)	P/N: 7005			General purpose protective wear for hands.
		Small	8415–01–352–6556	BX (20)	
		Medium	8415–01–352–6553	BX (20)	
		Large	8415–01–352–6554	BX (20)	
		X–Large	8415–01–352–6555	BX (20)	
104.	Gloves, Disposable, Latex Rubber, Pre–Powdered, Ambidextrous (Natural in color)	A–A–53513 (supersedes MIL–G–36592)			General purpose protective wear for hands.
		Small	6515–01–365–6183	PG (100)	
		Medium	6515–01–364–8553	PG (100)	
		Large	6515–01–364–8554	PG (100)	
105.	Coveralls, Cotton, Hook–Pile Fastener Tape (Green in color)	MIL–C–2202			Protective clothing for corrosion maintenance personnel.
		Small (Size 42)	8405–00–131–6507	EA	
		Medium (Size 46)	8405–00–131–6508	EA	
		Large (Size 50)	8405–00–131–6509	EA	
		X–Large (Size 54)	8405–00–131–6510	EA	
		XX–Large (Size 58)	8405–00–131–6511	EA	

Appendix B. Accessories for Corrosion Control (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
106.	Coveralls, One-piece, Disposable, Fire Resistant and Water Repellent (White in color)	A-A-50358			Protective clothing for corrosion maintenance personnel to protect against dirt, grease, paint, and low-hazard contaminants.
		X-Small	8415-00-601-0792	EA	
		Small	8415-00-601-0793	EA	
		Medium	8415-00-601-0794	EA	
		Large	8415-00-601-0797	EA	
		X-Large	8415-00-601-0801	EA	
		XX-Large	8415-00-601-0802	EA	
107.	Coveralls with Hood and Bootees, Disposable, "Bunny Suit" (White in color)	A-A-55196, Type I (supersedes MIL-C-87069)			Protective clothing for corrosion maintenance personnel.
		Small/Medium	8415-01-445-6565	EA	
		Large/X-Large	8415-01-445-6568	EA	
		XX-Large	8415-01-445-6588	EA	
108.	Overalls, Wet Weather (Green in color)	MIL-O-22776			Protective clothing for aircraft maintenance operations.
		Small	8405-00-985-7327	PR	
		Medium	8405-00-985-7328	PR	
		Large	8405-00-985-7329	PR	
		X-Large	8405-00-985-7330	PR	
109.	Parka, Wet Weather (Green in color)	MIL-P-82277			Protective clothing for aircraft maintenance operations.
		X-Small	8405-00-924-7935	EA	
		Small	8405-00-924-7936	EA	
		Medium	8405-00-924-7937	EA	
		Large	8405-00-924-7938	EA	
		X-Large	8405-00-924-7939	EA	
110.	Jacket, Extreme Cold Weather (Green in color)	MIL-J-82299			Protective outerwear for aircraft maintenance operations.
		Small	8415-00-349-9313	EA	
		Medium	8415-00-349-9314	EA	
		Large	8415-00-349-9315	EA	
		X-Large	8415-00-349-9316	EA	
		XX-Large	8415-00-349-9317	EA	

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
111.	Trousers, Extreme Cold Weather	MIL-T-21705			Protective outerwear for aircraft maintenance operations.
		Small (Size 27 to 30)	8415-00-575-1225	EA	
		Medium (Size 31 to 34)	8415-00-575-1230	EA	
		Large (Size 35 to 38)	8415-00-575-1240	EA	
		X-Large (Size 39 to 42)	8415-00-575-1246	EA	
		XX-Large (Size 43 to 46)	8415-00-575-1247	EA	
112.	Knee Pads, Strap-on, Industrial, Plastic		4240-00-595-3861	PR	Protection of knees with two adjustable web straps with buckles.
113.	Firemen's Boots, Knee Length (Black in color)	A-A-50371			Protective outerwear for aircraft maintenance operations.
		Size 7	8430-00-753-5937	PR	
		Size 8	8430-00-753-5938	PR	
		Size 9	8430-00-753-5939	PR	
		Size 10	8430-00-753-5940	PR	
		Size 11	8430-00-753-5941	PR	
		Size 12	8430-00-753-5942	PR	
		Size 13	8430-00-753-5943	PR	
		Size 14	8430-00-753-5944	PR	
		Size 15	8430-00-753-5945	PR	
114.	Footwear Covers for aircraft washdown	Medium	8430-00-911-2458	PR	Eliminates boot marks from aircraft surfaces painted with tactical scheme; increases traction.
		Large	8430-00-911-2459	PR	
		X-Large	8430-00-911-3771	PR	
115.	Apron, Utility, Full Length, Rubber, Acid Resistance (Black in color)	A-A-3104 (supersedes ZZ-A-605) (45" L x 35" W)	8415-00-634-5023	EA	Protective clothing for corrosion maintenance personnel against chemical splashes.
116.	Face Shield, Industrial, Adjustable	ANSI Z87.1 (supersedes L-F-36) Plastic (9" x 18" window)	4240-00-542-2048	EA	Protection of eye and face when cutting, grinding, or chipping metal or when handling hazardous chemicals. **NOTE:** Face shield is not for primary protection and should always be used with goggles.
117.	Goggles, Plastic, Safety-type (adjustable headband)	A-A-1110	4240-00-052-3776	PR	Eye protection. Can be worn over eyeglasses. Goggles are ventilated to reduce fogging.

Appendix B. Accessories for Corrosion Control (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
118.	Goggles, Plastic, Splash-proof, Indirect Venting (Light-green in color)	A-A-1110	4240-01-082-8928	EA	Protection of eyes from chemical splashes, impacts, and sparks. Ventilated for comfort and provides airflow to minimize lens fogging.
119.	Earplugs, Disposable, Vinyl foam material (Yellow in color)	P/N: 4-375	6515-00-137-6345	BX (400)	Hearing protection.
120.	Hearing Protector (Head-phone style with extra set of seals)	A-A-58084	4240-00-022-2946	EA	Hearing protection. Fits securely over ears to help prevent hearing loss or damage in loud work areas
121.	Aural Protector	MIL-A-23899 Ear Muffs Replacement Seal	 4240-00-759-3290 4240-00-979-4040	 EA PR	Hearing protection.
		Sealing Accessories			
122.	Sealant Dispensing Gun with 2.5 oz. Metal Retainer, Manual	Model 850 Gun (P/N: 221824)	5120-01-135-8344	EA	Application of sealants and adhesives.
123.	Sealant Dispensing Gun with 6 oz. Metal Retainer, Manual	Model 850 Gun (P/N: 221830)	5120-00-952-3507	EA	Application of sealants and adhesives.
124.	Sealant Dispensing Gun with 2.5 oz. Metal Retainer, Pneumatic	Model 250-A Gun (P/N: 250255)	5130-00-323-2287	EA	Application of sealants and adhesives. Gun handle is removable to allow for easier access in confined areas.
125.	Sealant Dispensing Gun with 6 oz. Metal Retainer, Pneumatic	Model 250-A Gun (P/N: 250065)	5130-00-924-6396	EA	Application of sealants and adhesives. Gun handle is removable to allow for easier access in confined areas.
126.	Repair Kit for Pneumatic Sealant Dispensing Gun	P/N: 240020 (Mfr.: PRC-DeSoto Int'l)	Open Purchase	KT	Model 250-A gun valve repair kit.
127.	Replacement Retainers for Manual Sealant Guns	Model 850 Retainers P/N: 226819 P/N: 226820	 5120-01-247-1639 5340-01-384-6120	 EA EA	 2.5 oz. metal retainer. 6 oz. metal retainer.

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
128.	Replacement Retainers for Pneumatic Sealant Guns	Model 250 Retainers P/N: 220256 P/N: 220928	 5120–00–693–8069 5120–00–693–8070	 EA EA	 2.5 oz. metal retainer. 6 oz. metal retainer.
129.	Hose Assemblies for Pneumatic Sealant Guns	5 ft. Hansen hose assembly (P/N: 280000) 10 ft. Hansen hose assembly (P/N: 280001) 20 ft. Hansen hose assembly (P/N: 280003) 25 ft. Hansen hose assembly (P/N: 280004)	4720–00–956–5312 4720–00–956–5313 4720–01–329–8602 4720–00–080–5159	EA EA EA EA	Replacement hose for Model 250–A gun. All assemblies come with a B–nut fitting and a quick disconnect attachment.
130.	Wrench for Pneumatic Sealant Guns	P/N: 240018	5120–00–996–1565	EA	Service wrench for adjusting pneumatic sealant guns.
131.	Mechanical Balance Beam (Dial–O–Gram Balance)	P/N: 1650 (Mfr.: Ohaus Corp.)	6670–00–957–3781	EA	Use for weighing out the proper ratio of base and accelerator to prepare sealant.
132.	Disposable Plastic Cartridges, Plungers, Seals, and Caps for Manual and Pneumatic Sealant Guns	**Cartridges** 2.5 oz. HD (P/N: 220316) 6 oz. HD (P/N: 220318)	 5120–00–694–9082 5120–00–673–1886	 EA EA	Empty cartridges for dispensing two–part sealants using the Model 250–A gun.
132.	(Cont.)	**Wiper Plungers** WP–Plunger LD (P/N: 220259)	 5120–00–276–9422	 EA	Use to assure complete dispensing and elimination of waste from cartridge. Fits both 2.5 and 6 oz. cartridges.
		Threaded Cap TC–Seal (P/N: 234411)	 Open Purchase	 EA	Use to cap and prevent leakage. Fits both 2.5 and 6 oz. cartridges.
		Flange Cap F–Cap (P/N: 220238)	 8125–00–410–8501	 EA	Use to prevent contamination. Fits both 2.5 and 6 oz. cartridges.

Appendix B. Accessories for Corrosion Control (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
133.	Sealant Smoothing Tools, Plastic	**Sealant spatulas**			Spatulas and spreaders for tooling and smoothing sealants and adhesives.
		P/N: 231349	5120-01-337-9415	EA	
		P/N: 226241	5120-01-297-7015	EA	
		P/N: 226242	5120-01-297-7016	EA	
		P/N: 226243	5120-01-297-7017	EA	
		Spatula Kit			The kit includes spatulas with P/Ns: 226241, 226242, and 226243.
		P/N: 226244	5120-00-056-3237	KT	
		Sealant scraper			Used for sealant removal from all surfaces.
		P/N: 234350	5120-01-298-6121	EA	
		Sealant spreader			Used for spreading sealants or adhesives onto flat surfaces.
		P/N: 229394	5120-01-337-9416	EA	
		Comb spreader			Used to spread sealants or adhesives while maintaining a uniform thickness.
		P/N: 229395	Open Purchase	EA	

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
134.	Plastic Nozzles with ¼” NPT male threaded end, Disposable	**Standard nozzles**			
		No. 252 (P/N: 220538)	5120–00–167–0150	EA	
		No. 254 (P/N: 220540)	5120–00–673–1885	EA	
		No. 255 (P/N: 233495)	Open Purchase	EA	
		No. 410 (P/N: 220542)	5120–00–801–0949	EA	
		No. 410 (P/N: 220543)	5120–00–055–4063	EA	45 degree angle.
		No. 415 (P/N: 227613)	5120–01–386–4480	EA	
		No. 420 (P/N: 220544)	5120–00–042–6577	EA	
		No. 430 (P/N: 220548)	5120–00–967–8151	EA	
		No. 430 (P/N: 220549)	5120–00–055–4062	EA	45 degree angle.
		No. 440 (P/N: 220550)	5120–00–773–3791	EA	
		No. 440 (P/N: 220551)	5120–00–670–1186	EA	45 degree angle.
		No. 620 (P/N: 220553)	5120–00–167–0152	EA	
		No. 620 (P/N: 220554)	5120–00–966–5373	EA	45 degree angle.
		No. 640 (P/N: 220555)	5120–00–822–7194	EA	
		No. 640 (P/N: 220556)	5120–00–167–0153	EA	30 degree angle.
		No. 640 (P/N: 220551)	5120–00–670–1186	EA	45 degree angle.
		No. 650 (P/N: 224494)	Open Purchase	EA	
		No. 820 (P/N: 220557)	5120–00–966–8270	EA	
		No. 840 (P/N: 220558)	5120–00–966–5371	EA	45 degree angle with 1/16” orifice.
		No. 840 (P/N: 220559)	5120–00–966–5372	EA	
		No. 840 (P/N: 220560)	5120–00–966–5382	EA	45 degree bend with 1/8” orifice.
		No. 8690 (P/N: 220606)	5120–00–966–8243	EA	9” vent duct nozzle.
		No. 1002 (P/N: 220561)	5120–00–055–4055	EA	
		No. 1004 (P/N: 220563)	5120–00–055–4054	EA	
		No. 1010 (P/N: 220565)	5120–00–055–4058	EA	

Appendix B. Accessories for Corrosion Control (Cont.)

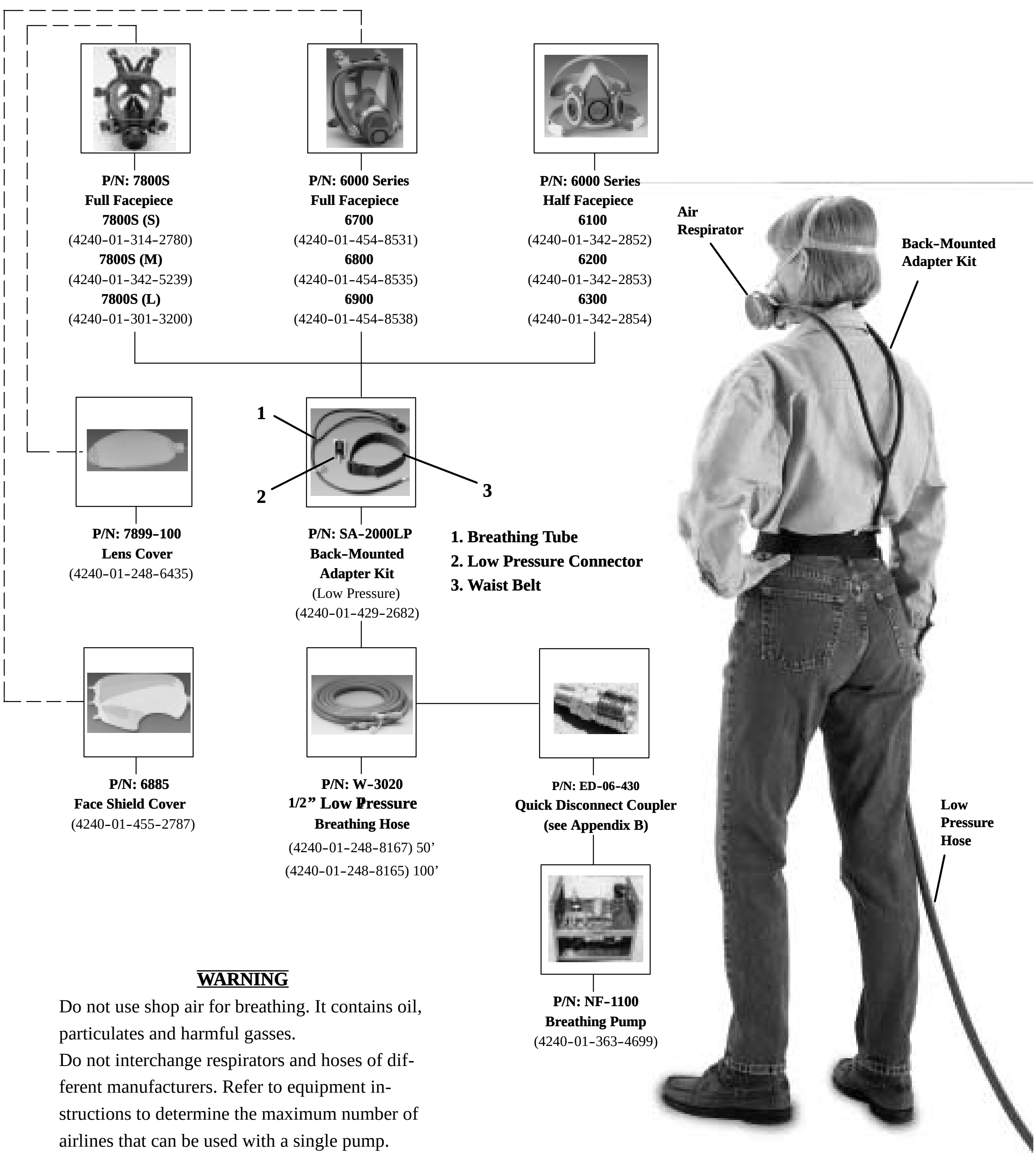
Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
134.	(Cont.)	**Fillet nozzles**			Applying sealant fillets over lap joints.
		No. 425 (P/N: 232499)	5120-01-386-4274	EA	
		No. 426 (P/N: 232500)	Open Purchase	EA	
		No. 427 (P/N: 232501)	Open Purchase	EA	
		No. 428 (P/N: 232502)	Open Purchase	EA	
		No. 429 (P/N: 232590)	Open Purchase	EA	
		Ribbon nozzles			
		No. 8607 (P/N: 220568)	5120-00-966-5381	EA	
		No. 8608 (P/N: 220569)	5120-00-966-8244	EA	
		No. 8610 (P/N: 220570)	5120-00-299-6790	EA	
		No. 8613 (P/N: 220572)	5120-00-966-5379	EA	
		No. 8615 (P/N: 220574)	5120-00-966-5378	EA	
		No. 8616 (P/N: 220577)	Open Purchase	EA	2-3/16” for windshield fillet.
		No. 8630 (P/N: 220581)	5120-00-966-5377	EA	
		No. 8630-9 (P/N: 220582)	5120-00-966-5376	EA	
		No. 8642 (P/N: 220585)	5120-00-293-4676	EA	
		No. 8643 (P/N: 220586)	5120-00-775-1670	EA	
		No. 8645 (P/N: 220587)	5120-00-138-1658	EA	
		No. 8646 (P/N: 220588)	5120-00-966-5374	EA	
		No. 8648 (P/N: 220589)	5120-00-966-5375	EA	
		Extension nozzle			
		No. 600E (P/N: 220552)	5120-00-670-1187	EA	6-3/8” extension.
		Floorboard nozzle			
		P/N: 231674	Open Purchase	EA	
		Funnel nozzle			
		1” (P/N: 231718)	Open Purchase	EA	
		2” (P/N: 231348)	Open Purchase	EA	
		Nozzle adapter			
		P/N: 229306	Open Purchase	EA	¼ NPT female thread.
		Edge fill nozzle			
		No. 444 (P/N: 234164)	Open Purchase	EA	Nozzle gives a slightly rounded edge fill and has a 0.40” thick flange to guide along panel edge.

Appendix B. Accessories for Corrosion Control (Cont.)

Item No.	Nomenclature	Specifications/Part No.	National Stock Number	Unit of Issue	Intended Use
135.	Fastener Sealing Nozzles (Countersink nozzles)	Size: 3/32” – 1/8” (P/N: 233244) Size: 3/16” – 1/4” (P/N: 233243) Size: 5/16” – 3/8” (P/N: 233451) Size: 1/4” hole (P/N: 231319) Size: 5/16” hole (P/N: 231320) Size: 3/8” hole (P/N: 231321) Size: 7/16” hole (P/N: 231560) Size: 1/2” hole (P/N: 231559)	Open Purchase Open Purchase Open Purchase Open Purchase Open Purchase Open Purchase Open Purchase Open Purchase	EA EA EA EA EA EA EA EA	Use to apply the required amount of sealant into the countersink area of fastener holes prior to installation. Comes with a threaded end to fit into cartridges. The nozzles are color coded for identification.
136.	Rivet Nozzles	Size: 3/32” (P/N: 234285) Size: 1/8” (P/N: 226837) Size: 5/32” (P/N: 226838) Size: 3/16” (P/N: 226839) Size: 3/16” – 120– (P/N: 234260) Size: 7/32” (P/N: 234284) Size: 1/4” (P/N: 226840) Size: 5/16” (P/N: 233051) Size: 3/8” (P/N: 233052)	Open Purchase 5120–01–413–8733 Open Purchase Open Purchase Open Purchase Open Purchase 5120–01–416–1683 Open Purchase Open Purchase	EA EA EA EA EA EA EA EA EA	Use to apply the required amount of sealant into the countersink and hole prior to fastening parts with rivets. The spring–loaded tip of the nozzle acts as a check valve allowing precise shots of material to be dispensed. Comes with a threaded end to fit into cartridges. The nozzles are color coded for identification.
137.	Roller Nozzles with ¼” NPT male threaded end	**Roller nozzle assembly** 1” (P/N: 232693) 2” (P/N: 232692)	 Open Purchase Open Purchase	 EA EA	Use to apply adhesives and sealants evenly over a wide areas of substrate (e.g. faying surface).
		Replacement roller 1” (P/N: 232701) 2” (P/N: 232702)	 5120–01–440–6984 Open Purchase	 EA EA	Use with any disposable cartridge. Can be solvent cleaned for re–use.

Appendix B. Accessories for Corrosion Control (Cont.)

Supplied Air Respirator: Dual Airline System with Full Facepiece (Back Mounted)



WARNING

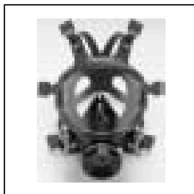
Do not use shop air for breathing. It contains oil, particulates and harmful gasses.

Do not interchange respirators and hoses of different manufacturers. Refer to equipment instructions to determine the maximum number of airlines that can be used with a single pump.

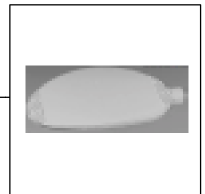
Figure B–1. Back Mounted Full Facepiece Respirator

Appendix B. Accesories for Corrosion Control (Cont.)

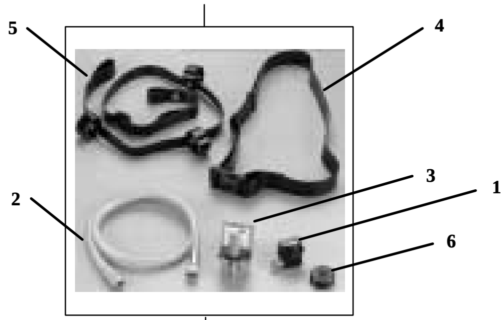
Supplied Air Respirator: Single Airline System with Full Facepiece (Front Mounted)



7800S (S)
(4240–01–314–2780)
7800S (M)
(4240–01–342–5239)
7800S (L)
(4240–01–301–3200)



P/N: 7899–100
Lens Cover
(4240–01–248–6435)

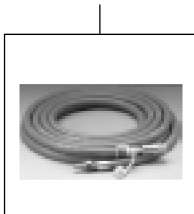


P/N: W–3197
Low Pressure Air Regulating Kit
(4240–01–251–8165)
Use with 1/2” ID hose (W–3020).
Includes 1 each of the following:

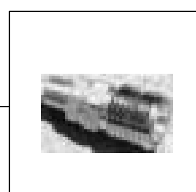
1. – W–3187 adapter assembly (4240–01–380–4955)
2. – W–3188 breathing tube (4240–01–380–4942)
3. – W–3195 low pressure connector (4240–01–251–8167)
4. – W–3217 waist belt (4240–01–301–4375)
5. – W–3229 shoulder strap (4240–01–314–4568
6. – 7890 plug for facepiece port (Open Purchase)

WARNING

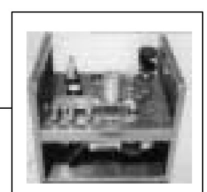
Do not use shop air for breathing. It contains oil, particulates and harmful gasses.
Do not interchange respirators and hoses of different manufacturers. Refer to equipment instructions to determine the maximum number of airlines that can be used with a single pump.



P/N: W–3020
1/2” Low Pressure Hose
(4240–01–248–8167) 50’
(4240–01–248–8165) 100’



P/N: ED–06–430
Quick Disconnect Coupler
(see Appendix B)

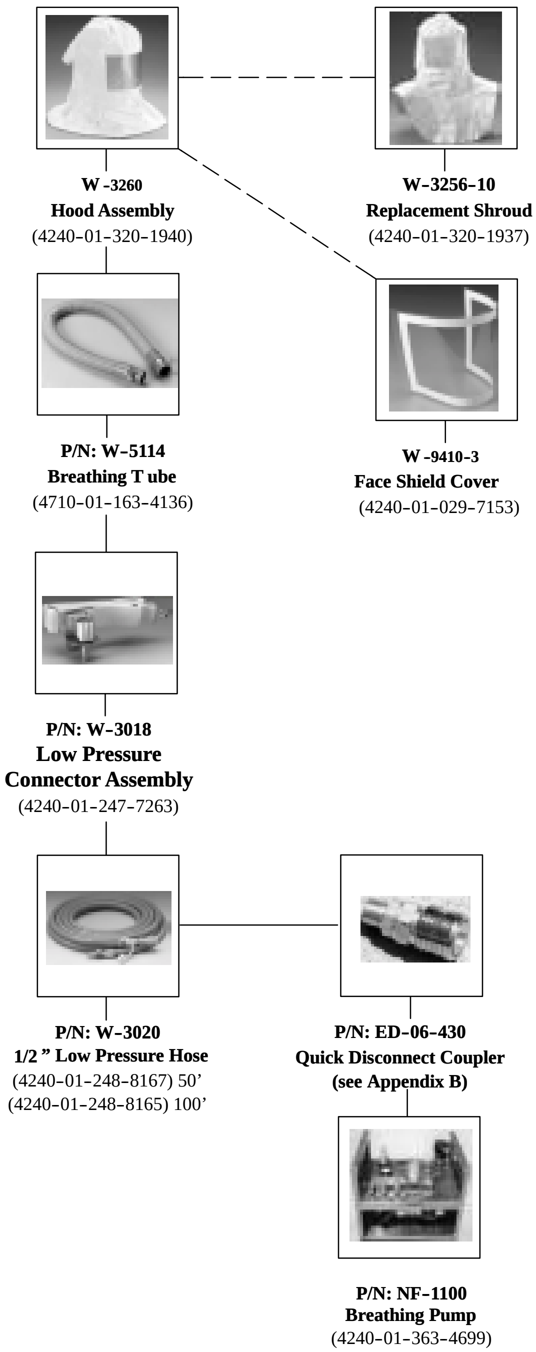


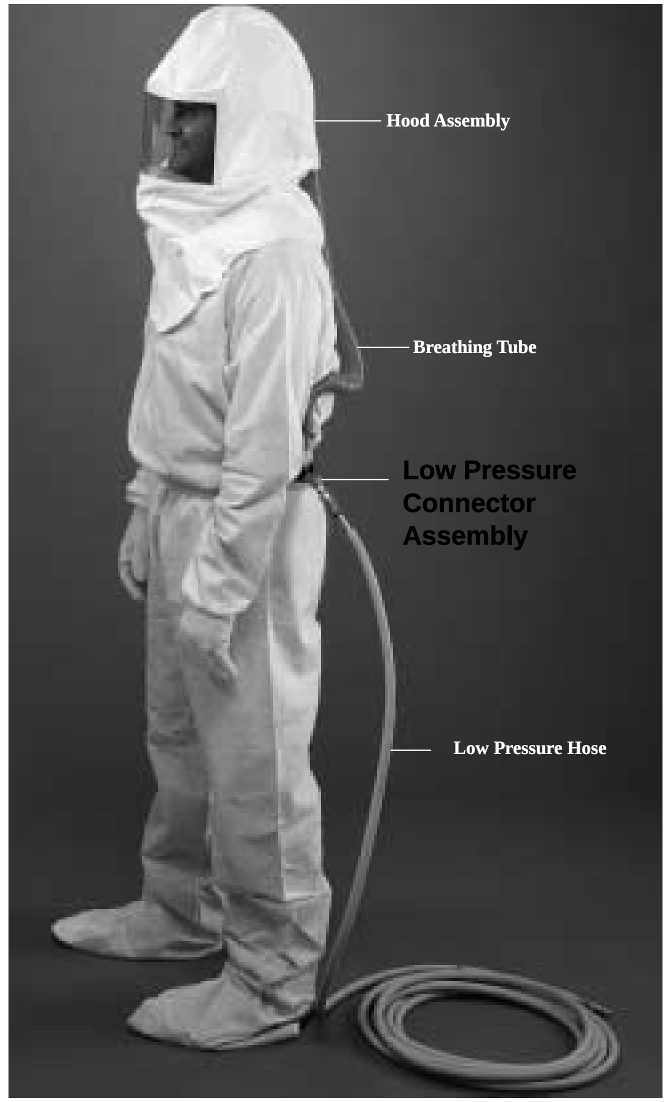
P/N: NF–1100
Breathing Pump
(4240–01–363–4699)

Figure B–2. Front Mounted Full Facepiece Respirator

Appendix B. Accessories for Corrosion Control Control (Cont.)

Supplied Air Respirator System with Hood





WARNING

Do not use shop air for breathing. It contains oil, particulates and harmful gasses.

Do not interchange respirators and hoses of different manufacturers. Refer to equipment instructions to determine the maximum number of airlines that can be used with a single pump.

Figure B-3. Hooded Air Respirator System

APPENDIX C

SUPPLEMENTARY REQUIREMENTS FOR NAVY AIRCRAFT

AIRCRAFT CLEANING

This appendix details aircraft and engine cleaning. For corrosion charts of the specific aircraft, refer to the applicable maintenance instruction manual (MIMs), or contact the Cognizant Field Activity (CFA) or Fleet Support Team (FST) of the aircraft.

C–1. AIRCRAFT CLEANING. Cleaning compounds and materials which appear only in Appendices D and E are not authorized for cleaning Navy and Marine Corps aircraft.

C–2. EQUIPMENT FOR TURBINE ENGINE CLEANING.

C–2.1. Jet engine corrosion control cart. The corrosion control cart is designed for cleaning and rinsing aircraft jet engines (see Figure C–1). It is a trailer–mounted, self–contained mobile unit designed for shipboard use and shore based operations. The cart consists of a 33–gallon capacity solution tank, work platform area on top of the solution tank, water supply hose and applicator storage area on the right hand side, two air cylinders mounted on the left hand side to supply the air pressure needed to discharge the water solution from the solution tank, and the instruction plate and schematic diagram mounted on the left hand side to provide information about operating the unit. The 33–gallon capacity solution tank is divided into two separate compartments: a preservative compartment at the front end of the unit consisting of approximately 7 gallons capacity, the water compartment at the rear end of the unit consisting of approximately 26 gallons capacity. On top of each compartment is a filler opening and provided at the bottom of each compartment is a plug for drainage purposes. The operational instructions of the cart are listed in NAVAIR 19–20D–1 (Jet Engine Corrosion Control Cart). Washing with MIL–PRF–85704 (Gas Path Cleaner) shall be performed as follows:

a. Fill the 7–gallon forward tank with 1 gallon of MIL–PRF–85704, Type II and 4 gallons of fresh water, or with 5 gallons of MIL–PRF–85704, Type II RTU (ready–to–use). Then fill the 26–gallon aft tank with fresh water.

b. Prepare the aircraft for turbine engine washing in accordance with the applicable maintenance requirements.

c. Spray the cleaning solution or fresh water as required (see Page 3–17 for additional information).

C–2.2. Corrosion control spray unit, trailer mounted. The spray unit (see Figure C–2) stores and controls the delivery of water, preservative oil, and cleaning solutions used for servicing an aircraft. It is a self–contained sprayer mounted on a towable trailer. The spray unit consists of a 200–gallon water tank and a 10–gallon oil/cleaning solution tank. Compressed air from the compressor assembly pressurizes the tanks for delivery of fluids. The solution tank is a reservoir for storage of preservative or cleaning solutions. Fresh water from the water tank is usually used during corrosion control for rinsing. The 4:1 mixer assembly mixes four parts water to one part chemical in the solution tank. The unit can also supply compressed air directly to the aircraft being serviced. The unit is secured to an aluminum chassis mounted on a four–wheel running gear. Operating instructions of the unit are listed in NAVAIR 19–20D–2 (Corrosion Control Spray Unit).

Figure C-1. Jet Engine Corrosion Control Cart

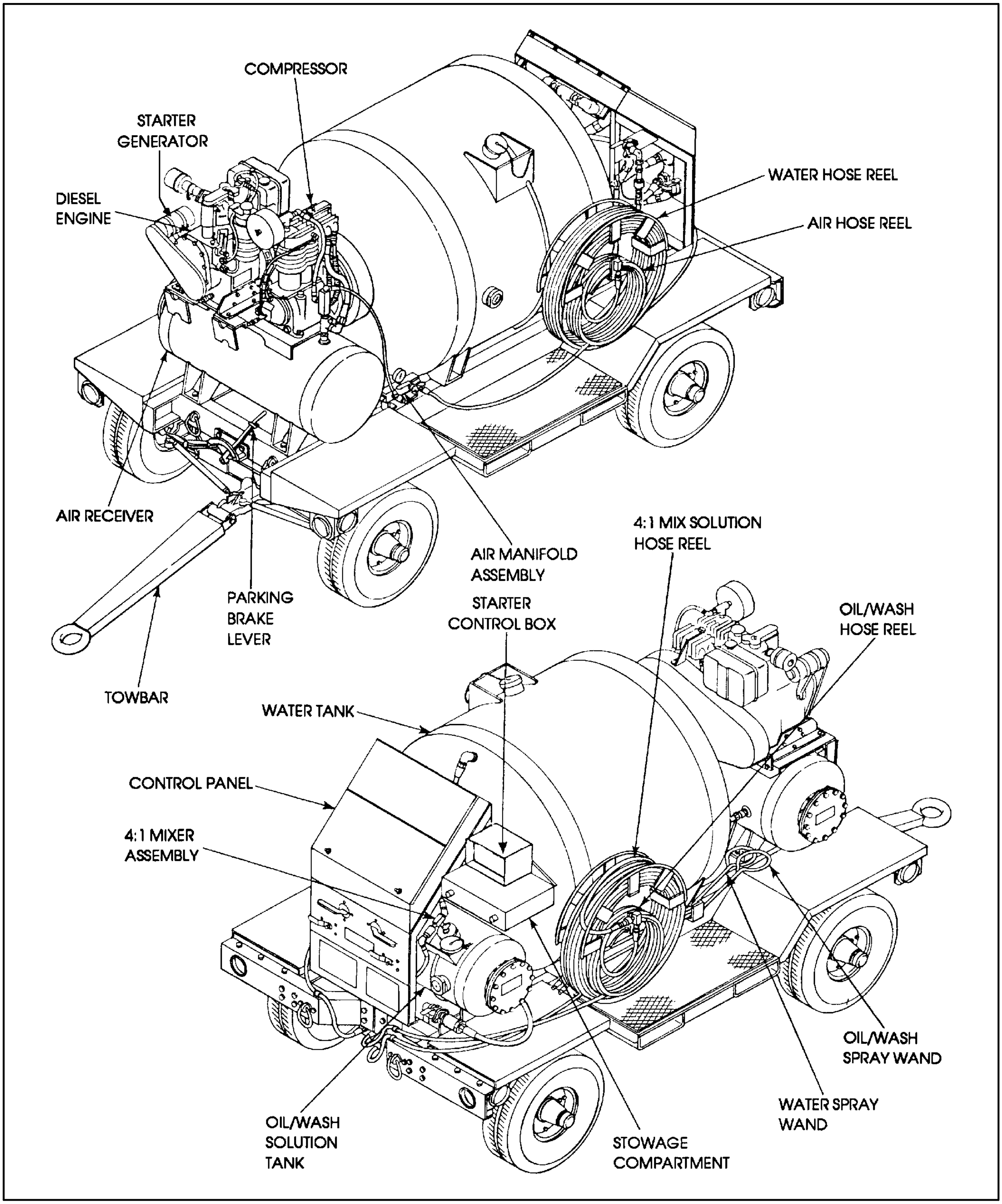


Figure C-2. Corrosion Control Spray Unit

APPENDIX D
(FOR ARMY USE ONLY)

SUPPLEMENTARY REQUIREMENTS FOR ARMY AIRCRAFT

This appendix consists of four sections. Section I pertains to aircraft cleaning, Section II covers chemical corrosion removal, and treatment procedures for specific metals, Section III covers the treatment of specific areas, Section IV pertains to decontamination procedures for salt water and microbiological growth contamination, Section V covers the identification of metals, and Section VI contains a list of consumable materials.

SECTION I

CLEANING

D–1. FREQUENCY OF CLEANING. The frequency of cleaning of army aircraft shall be 30 days, with the following exceptions, unless aircraft are stationed within two miles of salt water. Extended or low level operations over salt water require daily fresh water rinsing. Cleaning procedures and materials shall be in accordance with Chapter 3 of this manual.

SECTION II

CORROSION REMOVAL AND SURFACE TREATMENT

D–2. CHEMICAL CORROSION REMOVAL AND PREPAINT TREATMENT OF ALUMINUM ALLOYS.

WARNING

Wear acid–resistant gloves, chemical or splash proof goggles, protective mask, and protective clothing when working with acidic compounds. If acid accidentally contacts the skin or eyes, flush off immediately with clean water. Report to the medical facility if eyes are affected or if skin is burned.

Magnesium surfaces should be protected and subsequently treated as prescribed in Chapter 5 of this manual.

CAUTION

Corrosion removal compound (MIL–C–38334) is for use on aluminum alloys only and shall not be used on or rinsed over magnesium. It shall be used on aircraft only when required to remove corrosion as a pre–paint treatment and shall not be used solely for the purpose of enhancing the appearance of the aircraft or equipment. The use of this compound under the premise of general corrosion removal is also prohibited. When this compound is accidentally splashed or spilled, remove immediately by rinsing with water or wiping with a wet rag. Keep a wet rag on hand at all times for the removal of spills or splashes.

When working with any acidic solution for corrosion removal, keep the solution confined to the area being treated. The acidic solution shall be kept away from operating mechanisms, magnesium alloys, and steel parts, especially steel screws and fasteners in stressed panels (e.g., wing).

D–2.1. Masking. All parts and assemblies, especially cadmium plate items and hinges susceptible to damage by the acidic compound, shall be masked and/or protected. Mask all openings leading to the primary structure and any other openings which might allow the solution (uncontrolled) to get into the aircraft or equipment interior. Specific examples of extremely critical areas on most aircraft are the landing gears, engines, main framing and support members of the landing gears, engines, elevons, elevators, rudder, and wings and wing stubs. Masking can be accomplished by using waterproof barrier paper (MIL–B–131, Class 1) and masking tape (MIL–T–21595, Type I).

D–2.2. Cleaning. Surfaces should be thoroughly clean before application of the corrosion removal compound (see Chapter 3). For pitted or heavily corroded areas the compound will be more effective if applied warm (140_F (60_C) maximum) followed by vigorous agitation with a non–metallic acid–resistant brush (H–B–643) or an aluminum oxide abrasive nylon mat (A–A–58054). The application of the remover on the heavily corroded areas may have to be repeated several times to completely remove the corrosion. When using the acid remover, be sure to allow a sufficient dwell time (12 to 15 minutes) before rinsing.

D–2.3. Inspection. After each application, examine the pits and/or corroded area with a 10 power magnifying glass to determine if another application is required. Corrosion still on the area will appear as a powdery crust slightly different in color from the uncorroded base metal. Darkening of the area due to shadows and reaction from the acid remover should not be considered.

D–2.4. Corrosion removal compound (MIL–C–38334).

CAUTION

When using corrosion removal compound on aluminum alloy surfaces, take particular care to keep acid out of faying surfaces, butt joints, seams, and crevices.

CAUTION

When using the flap brush to remove corrosion, some particles of the brush will break away. Action shall be taken to control the particles or abrasives that do break away and prevent them from contaminating systems or components. Prior to accomplishing corrosion removal from severely pitted areas, check the component or item against the applicable aircraft or overhaul manual for the possibility of exceeding authorized or allowable metal removal limits.

D–2.4.1. The corrosion removal compound (MIL–C–38334) material is basically intended for use as a pretreatment prior to the application of a protective coating. However, it also can be used to remove corrosion products from aluminum alloy materials or items (e.g., skins, stringer, ribs in wings, tubing, or ducts). The wipe-off technique is recommended for ducting, tubing, stringer, and similar parts, followed by a thorough rinsing of the treated area with clean water. In cases of severe pitting, the chemical method of removal may be aided by hand agitating (lightly) the pits with a corrosion resistant steel wire (0.005 to 0.006 inch maximum diameter of filament wire) brush (MIL–B–15319) or by agitating with a power driven nylon flap brush, Density 5, Type A, grade fine or very fine (3M Corp. or equal).

D–2.4.2. General application procedure.

a. Pre–clean surfaces in accordance with Chapter 3.

b. Survey or inspect equipment and determine area(s) that should be treated with the corrosion removal compound, using criteria cited in Chapter 4. Pitted surfaces and/or aluminum surfaces with a powdery metallic residue which was not removed by cleaning should be treated. If the aircraft is being prepared for complete painting or repainting, prepare all cleaned bare aluminum surfaces for treatment.

D–2.4.3. Mask applicable areas (see D–2.1).

c. Set up application equipment, put on protective clothing, and prepare corrosion removal and prepaint solution by diluting Type I material with an equal volume of water before using. Mix the compound in wood, plastic, or plastic lined containers only. Follow the manufacturer's mixing instructions.

NOTE

MIL–C–38334, Type I corrosion removal solution has a one year shelf life; therefore, it shall not be used after one year from the date of manufacture. MIL–C–38334, Type II material should be used within 90 days after dissolution.

d. Apply the corrosion removal solution by spray, mop, sponge, or brush. When applying a the solution on large surface areas, begin application on lower surface and work upward, with a circular motion, brushing enough to loosen the surface film. Allow the solution to remain on the surface for approximately 12 minutes, then rinse away with clean tap water. Chromate conversion coating (MIL–C–81706) shall be applied immediately thereafter. Refer to paragraph 5–9 for prepaint treatment application instructions.

NOTE

The final protective paint system or primer shall be applied only on a completely dry surface within 48 hours after applying the conversion coating. A second conversion coating shall be applied over the previous application if more than 48 hours has elapsed since the first conversion coating was applied.

D–3. CHEMICAL CORROSION REMOVAL AND TREATMENT OF MAGNESIUM ALLOYS.

WARNING

When preparing the chromic acid pickle solution, add chromium trioxide to water; do not add water to chromium trioxide.

D–3.1. The chromic acid pickle solution described herein may be used to remove surface oxidation and light corrosion products from magnesium surfaces. It is not considered adequate where deep pitting or heavy corrosion has occurred, which require mechanical methods, nor is it satisfactory for removing sand or the effects of blasting. The chemical method causes less reduction in section thickness. This method shall not be used for parts containing copper based inserts unless the inserts are masked off. Excessive amounts of anions, such as chlorides, sulfates, and fluorides, must not be allowed to build up in the solution, as these anions tend to coat or etch the metal rather than clean the surface.

D–3.2. Chromic acid pickle solution. Mix 24 ounces of chromic acid and enough water to make one gallon in a container constructed from lead lined steel, stainless steel, or 1100 aluminum.

D–3.3. Application procedure.

a. Mask off nearby operating mechanisms, cracks, and plated steel to keep the solution from attacking them.

b. Heat the solution to 190_ to 202_F (88_ to 94_C). The solution can be applied at room temperature for a longer reaction time, if desired.

c. Carefully apply the chromic acid solution to the corroded area with an acid resistant brush (H–B–643). Allow the solution to remain on the surface for approximately 15 minutes.

d. Thoroughly rinse the solution from the surface with plenty of clean water.

e. Repeat the preceding sequence as necessary until all corrosion products have been removed and the metal has a bright appearance.

f. Apply the chemical pretreatment and final protective finish recommended for the area.

D–3.4. Pre–treatment processes (brush application. Chemical pre–treatment, such as the chromic acid brush–on solution, provides a passive surface layer with an inhibitive characteristic that resists corrosive attack and also provides a bond for subsequent coatings. Properly applied magnesium pre–treatment tend to neutralize corrosion media in contact with the surface. Numerous type treatments are available; however, for the purpose of this manual, the following brush–on treatment corresponding to Type VI of Specification MIL–M–3171 is given. The pre–treatment shall be applied immediately after paint removal and washing in order to prevent corrosion and surface deterioration.

D–3.4.1. Chromic acid brush–on pretreatment. The chromic acid brush–on pretreatment may be applied to all magnesium parts that require touchup. This treatment is generally used in refinishing procedures or when parts and assemblies are too large to be immersed. This treatment is less critical to apply than the other brush–on treatments, is relatively inexpensive, not as harmful when trapped in faying surfaces and does not present the toxicity hazards of the other brush–on treatments. Ensure that all contaminants, grease, and oil are removed prior to the treatment process.

D–3.4.1.1. Preparation.

WARNING

When preparing the chromic acid brush–on pretreatment, add the chemicals to the water in the order shown below, stirring the solution vigorously, either mechanically or by agitation, for at least 15 minutes. Avoid skin contact or inhalation of acid fumes.

D–3.4.1.2. Add 1–1/3 ounces (37.8 grams) of technical grade chromic acid (O–C–303) and one ounce (28.3 grams) of calcium sulfate (CaSO4–2H20) to enough water to make one gallon in a container constructed from stainless steel, aluminum, vinyl, polyethylene, or rubber. The operating temperature range is 70_ to 90_F (21_ to 32_C). After mixing, the pH of the solution should be between 1.1 and 1.6. Adjust with acid if the pH is greater than 1.6 and with water if the pH is less than 1.1.

D–3.4.1.3. Application procedure.

a. Clean the surfaces to be treated (see D–2.2). A water break test is recommended if the cleanliness of the surface is in doubt.

b. Apply the coating solution by brush, swab, or a low pressure, non–atomizing spray. Keep the receiving surfaces wet throughout the treatment operation until the required or specified coating film is produced. Under optimum conditions (i.e., at temperatures of 70_F (21_C) or above, and using fresh materials), the time required is usually one to five minutes; up to one to two minutes of treatment should produce a brassy film, and three to five minutes should produce a dark brown coating. Under adverse conditions, and if the desired or specified finish color is not produced in the specified time, the treatment may have to be prolonged (up to 20 to 30 minutes in some instances) until the proper finish is obtained. For good paint adhesion, a dark brown color free of powder is considered best. The color may vary in using different manufacturer's materials.

NOTE

Too long an exposure to the brush–on solution produces coatings which will powder and impair adhesion of applied paint finish and films.

c. The coating should be closely observed during the treatment for color changes, rinsed with cold running water when the desired condition or color is reached, and air dried. The preparation and use of test panels, made of the same material and under the same conditions, prior to starting the actual treating operation may be used as an aid in determining the application time required to produce the necessary coating. A good coating is uniform in color and density, adheres well, and is free of loose powder.

d. Apply wash primer (MIL–C–8514) to the treated surface as soon as practical after thorough drying.

e. Apply recommended final protective finish.

D–3.5. Paint systems. Use paint systems which are recommended for aluminum (see TM55–1500–345–23). Treat touch–up of broken conversion films or magnesium as described in D–3.6 prior to the application of any paint system.

NOTE

The final protective paint system or primer shall be applied on a completely dry surface and shall be applied within 48 hours after application of the MIL–M–3171 or chromic acid brush–on pretreatment. A second pretreatment coating shall be applied over the previous if more than 48 hours have elapsed since the previous application.

D–3.6. Repair of MIL–M–45202 coatings. Some magnesium parts in current aircraft have been originally protected by proprietary electrolytic processes. The HAE process can be identified by the brown to mottled gray appearance of the unpainted surface. DOW 17 coatings have a green to grayish–green color. Coatings of the electrolytic type are thicker than those applied by immersion or brushing. Electrolytic finishes cannot be restored in the field. When failure occurs, remove corrosion products, touch–up bare magnesium with chemical treatment solution (MIL–M–3171), and repaint the part. Take care to minimize the removal of these coatings.

D–4. CHEMICAL CORROSION REMOVAL AND TREATMENT OF FERROUS METALS OTHER THAN STAINLESS STEEL.

WARNING

The phosphoric acid–type corrosion remover (MIL–C–10578, Type III) contains a strong acid. Protect hands, face, and eyes, wear protective clothing, and avoid prolonged inhalation of vapors.

Corrosion removing compound, sodium hydroxide base (MS–36429) is highly alkaline, and, therefore, harmful to the skin and eyes. Operators should wear rubber gloves, aprons, and chemical or splash proof goggles and use adequate ventilation when working with this material.

CAUTION

Do not use the phosphoric acid–type corrosion remover (MIL–C–10578, Type III) if the danger of trapping the material in crevices or recesses exists.

Steel parts heat–treated above Rockwell C40 (180,000 psi) tensile strength are subject to hydrogen embrittlement; therefore, the use of the phosphoric acid–type corrosion remover (MIL–C–10578, Type III) is prohibited.

CAUTION

Do not use the sodium hydroxide base corrosion removing compound (MS–36429) to remove corrosion from aluminum alloys. Do not process dissimilar metals in the solution.

D–4.1. Chemical corrosion removal is recommended for use where there is no danger of the chemicals becoming, trapped in crevices or recesses. Chemical rust remover are either acid or alkaline. The acid type (MIL–C–10578, Type III) is intended for removal of red rust and black oxide formations by either immersion or brush application of the chemical. The alkali type (MS–36429) is intended for removing red rust by immersion treatment.

D–4.2. Application procedures.

D–4.2.1. Brush–on method. Phosphoric acid–type corrosion remover (MIL–C–10578, Type III) is used to remove rust and condition the metal surface prior to painting. Type III material should always be rinsed off with water after application.

a. Protect adjacent components to prevent damage by scale, chips, corrosion products, or chemicals.

b. Remove any grease or soil by method outlines in Chapter 3 of this manual.

c. Remove heavy rust by chipping and/or wire brushing.

d. Add one part of the concentrated material as received to one part of water by volume, adding the acid to the water. Use acid resistant mixing tanks.

e. After proper dilution, apply the material to the corroded area with brush or swab. Allow the material to remain long enough loosen the rust (usually two to 10 minutes, depending on the degree of rusting).

f. Remove the by with hot water. The material must be completely rinsed from the part.

g. If corrosion is still evident, repeat steps e. and f.

h. Dry the part and immediately apply the protective paint or other corrosion preventive finish.

D–4.2.2. Immersion method (acid type). Use inhibited phosphoric acid–type rust remover (MIL–C–10578, Type III) for small parts. Corrosion resistant steel tanks are preferred for the immersion treatment.

a. Remove grease and oil as outlined in Chapter 3 of this manual.

b. Remove heavy rust by chipping and/or wire brushing.

c. Mix the rust remover as described above.

d. Immerse the parts in the solution only long enough to loosen the rust. For removal of heavy rust, the solution can be heated to 140_F (0_C) maximum. Agitate the parts in the solution to further increase the rate of rust removal.

e. Rinse in a continuously overflowing cold water rinse tank, if water rinse tank is available, or spray with clean, preferably hot, water.

f. Dry the parts and immediately apply the final protective paint or other corrosion preventive finish.

D–4.2.3. Immersion method (alkali type). Use an alkali type corrosion remover for removing corrosion from small parts with or without attendant paint, grease, or other surface coating. Corrosion removing compound, sodium hydroxide base (MIL–C–14460) is suitable for rust removal by simple immersion of the parts. The compound will also remove grease, paint, and rust from the parts, and may be used to clean copper and brass and strip phosphate coatings. In addition, rust can be removed from critical or machined surfaces with the compound without causing dimensional change of the part.

g. Prepare alkaline rust remover in accordance with manufacturer's instructions as printed on the container. The usual concentration employed for Type I material is five pounds per gallon of water. Carbon steel or corrosion resistant steel tanks may be used.

h. Immerse parts in the rust remover solution. Rust removal time varies with the extent of the rust. Temperatures up to the boiling point of the solution may be used to increase the rate of rust removal.

i. Rinse thoroughly in clean (preferably hot) water.

j. Dry thoroughly and immediately apply final protective finish or other corrosion preventive compound.

D–4.3. Paint systems. See TM5–1500–345–23 for paint systems applicable to aircraft in general. In addition, see the aircraft maintenance manuals overhaul manuals, or parts drawings for specific paint systems.

D–5. CHEMICAL CORROSION REMOVAL AND TREATMENT OF STAINLESS STEEL AND NICKEL BASE ALLOYS.

CAUTION

Take care to protect surrounding unaffected areas next to area being treated by avoiding leakage of chemicals into recesses or inaccessible area in order to prevent additional damage from corrosion attack.

The heat–treatable straight–chromium alloys, such as AISI Types 403, 410, 420, et al., are susceptible to cracking when placed in pickling solutions; therefore, corrosion removal by brushing or grinding is recommended.

D–5.1. Chemical removal of corrosion is recommended for severely corroded areas where there is no danger of the chemicals becoming entrapped in recesses or structural complexities or the possibility of damaging surrounding metals and plating.

D–5.2. Corrosion removal procedure for installed components which are not readily removable.

a. Protect adjacent unaffected areas not being treated to prevent additional corrosive attack. When internal corrosion is evident, the components shall be removed and processed through an overhaul facility in accordance with the specific directives.

b. Protect nearby non–corrosion–resistant steel alloys, plated areas, copper–bronze alloys, aluminum alloys, braided flexible lines, and operating mechanisms to prevent the chemical treating solution from coming in contact with those areas.

c. Remove all loose corrosion by brushing with stainless steel wool or No. 400 carborundum paper. Remove loose particles by wiping with a clean cloth dampened with approved compliant cleaning solvents.

d. In areas where there is no danger of liquid oxygen spillage, corrosion may be removed with phosphoric acid base rust remover (MIL–C–10578).

e. Thoroughly rinse all chemical corrosion remover from the area.

f. Allow the area to dry, then apply final protective finish or other corrosion preventive if required.

D–5.3. Pickling for corrosion removal.

WARNING

The scale loosening solution, the pickling solution, and the passivating solution all contain strong acids. Observe the standard safety precautions for handling acids. Wear protective clothing, avoid inhaling fumes, provide adequate ventilation, and always add acid to water.

a. Mixtures of nitric acid (O–N–350) and hydrofluoric acid (O–H–796) in water are recommended. The correct percentage content of the two acids for a given corrosion removal job shall be determined by testing. (See D–5.2.c). The nitric acid content may vary from 5 to 50% and the hydrofluoric acid from 0.5 to 5%, both by volume. Normally, an aqueous mixture containing 12 to 15% nitric acid and 1% hydrofluoric acid is used to remove light scale or corrosion. The percentage of hydrofluoric acid may be increased to remove heavier scale or corrosion. The more nitric acid present with respect to hydrofluoric acid, the less rapid the corrosion or scale removal. Nitric acid acts to inhibit the action of hydrofluoric acid. Rubber lined or Koroseal tanks may be used to hold the solutions.

b. The pickling temperature may be adjusted from room temperature to 140_F (0_C). Higher temperatures shall be avoided to reduce evaporation loss of hydrofluoric acid. Temperatures below 120_F (49_C) should be used if intergranular attack is experienced in localized areas, such as weld zones. Type 300 series stainless steels may be used to manufacture steam coils to heat the solution. The heating coils should be installed so that they are easily replaced since they will be corroded by the solution.

Table D–1. Control of the Dissolving Action of Nitric–hydrofluoric Acid Solution

	Dissolving Or Pickling Action Is More Severe		Dissolving Or Pickling Action Is Less Severe
1.	When the nitric acid content is decreased. When the hydrofluoric acid content is increased.	1.	When the nitric acid content is increased. When the hydrofluoric acid content is decreased.
2.	When the temperature is increased.	2.	When the temperature is decreased.
3.	When immersion time is increased	3.	When immersion time is decreased

c. Optimum pickling conditions (temperature, time, and acid concentration) shall be determined by exposure of test panels to all conditions of the cleaning cycle. Excessive etching or intergranular attack of the base metal shall be avoided.

(1) Make test panels, 1 x 4 inches, of the same material as that of the compound being cleaned. Process the test panels through the complete cleaning and pickling cycle.

(2) If etching, intergranular attack, or metal loss is excessive (i.e., would cause component to be condemned), or if cleaning is not complete, adjust the acid concentration, immersion time, or solution temperature until the desired result is obtained. Table D–1 shows the effect of the variables (acid concentration, immersion time, and solution temperature) on the pickling action of the solution.

d. The following procedures are merely guidelines for acid pickling. Competent operators must establish specific procedures by test as outlined in step c. above. A scale loosening procedure is included for use only if severe scale is encountered and it is desired to loosen the scale by chemical means. Normally, heavy scale may be removed by mechanical means prior to acid pickling. A passivating procedure is also included and may be used following pickling. Solvent or vapor degreasing shall precede the following procedure:

(1) If necessary, remove severe scale by a mechanical method.

(2) If necessary, loosen severe scale by immersing parts in an 8 to 1096 (by weight) solution of sulfuric acid (O–S–809) in water at 150_ to 160_F (66_ to 71_C) for approximately five minutes. Observe results and repeat if required. Scrub as required to remove sludge.

(3) Rinse parts quickly and thoroughly in clean, hot water.

(4) Transfer parts to the nitric–hydrofluoric acid pickling bath. A typical bath consists of 15% nitric acid (O–N–350), 2 to 3% hydrofluoric acid (MIL–A–24641), and 82 to 83% clean water, all by volume.

(5) Immerse parts for five to 15 minutes at a temperature of 60_ to 140_F (16_ to 60_C). Scrub or agitate as required.

NOTE

The required acid concentration, temperature, and time shall be determined by test prior to starting pickling operations (see D–5.2.c). New welds should be mechanically vibrated during the pickling operations.

(6) Immediately rinse thoroughly in clean, hot water.

(7) Transfer the parts to a passivating solution for treatment as follows:

(a) Immerse parts in an aqueous solution containing 20 percent by volume nitric acid (O–N–350) at ordinary room temperature for 30 minutes.

(b) Rinse in clean, hot water.

(c) Immerse parts for one hour in a hot aqueous solution {140_ to 160_F (70_ to 71_C)} containing 5% sodium dichromate.

(d) Rinse thoroughly.

D–5.4. Paint systems. Stainless steel parts normally are not painted. However, where extreme corrosive conditions are encountered or where organic finishes are required for decorative purposes, finishing systems may be found in TM 55–1500–345–23, the overhaul manuals, or on the parts drawings.

D–6. CHEMICAL CORROSION REMOVAL AND TREATMENT OF COPPER AND COPPER BASE ALLOYS. Copper and copper alloys are relatively corrosion resistant, and attack on such components will usually be limited to staining and tarnish. Generally such changes in surface conditions are not dangerous and should ordinarily have no effect on the function of the part. Copper corrosion is evidenced by the accumulation of colored products. Corrosion can be removed from copper with phosphoric acid base rust remover (MIL–C–10578), provided that there is no danger of trapping the acid in the crevices or recesses.

D–6.1. Corrosion removal from immovable areas.

a. Protect adjacent components to prevent damage by chemical agents.

b. Remove grease or soil from the area to be treated with cleaner and/or solvent (see Chapter 3).

c. Remove corrosion with phosphoric acid base rust remover (MIL–C–10578).

d. Rinse the area thoroughly, dry, and apply final protective paint or other finish if required.

D–6.2. Corrosion removal from removable components.

a. Components which can be disassembled can be treated in immersion tanks. The tanks should be manufactured from or lined with stainless steel, lead, ceramic, glass, or acid resistant rubber. Immersion racks should be manufactured from stainless steel or Monel. The proper conditions (time, temperature, and acid concentration) for the process should be determined by test, using panels of the same material which is to be treated.

b. Disassemble the component as necessary. Do not simultaneously process dissimilar metals in the acid bath.

c. Degrease parts by immersion, spray, or vapor cleaning.

d. Immerse parts in a solution containing 5 to 10% sulfuric acid (O–S–809), by volume, in water; add the acid to the water, not the water to the acid. Maintain solution between 60_ and 120_F (15_ and 49_C). The required temperature, immersion time, and acid concentration shall be determined by test.

e. Rinse thoroughly.

f. If a red stain appears on the parts following the above treatment, remove the stain by immersing parts in a solution containing sulfuric acid (O–S–809), 4 to 10% by volume, sodium dichromate, 4 to 8 ounces per gallon of solution, and water, remainder.

g. Maintain the above solution at 60_ to 120_F (15_ to 49_C). The required temperature, immersion time, and acid concentration shall be determined by test.

h. Rinse thoroughly. This will remove any residual acid, which could cause staining of the metal surface.

i. Dry rapidly, preferably with hot air. Rapid drying will prevent water stains on the metal surface.

D–6.3. Paint systems. Normally copper and copper alloys are not painted. However, if paint is required for decorative or other purposes the finishing systems are listed in TM 55–1500–345–23, the aircraft maintenance manuals, overhaul manuals, or parts drawings.

D–7. CHEMICAL CORROSION REMOVAL AND TREATMENT OF TITANIUM AND TITANIUM–BASE ALLOYS.

<u>CAUTION</u>

Titanium is susceptible to hydrogen embrittlement in acid solutions; therefore, the acid pickle should be used only when other corrosion removal methods are not adequate. Assign competent operators to monitor the process.

D–7.1. An acid pickle will remove most oxide coatings from titanium, provided that the scale was formed at temperatures below 1000_F (540_C). Gray or black oxides should be removed by a mechanical method, such as abrasive blasting, prior to the acid pickle to prevent pitting of the titanium.

a. If present, remove gray or black oxide by mechanical means.

b. Remove soil by vapor degreasing or other cleaning method as outlined in Chapter 3.

NOTE

The required acid concentration and immersion time shall be determined by test prior to the pickling operation.

c. Immerse parts in a solution normally containing 20% nitric acid (O–N–350) and 3% hydrofluoric acid (MIL–A–24641) in water, by volume. Maintain the solution at the normal room temperature. Allow the parts to remain in the solution only long enough to remove the oxide coats. Intermittent wiping with a brush or cloth during the pickling operation will facilitate oxide removal with a minimum of pitting.

d. Rinse thoroughly in cold running water, air dry, or dry in air oven at 180_ to 240_F (82_ to 116_C).

e. Apply final protective finish, if required.

D–7.2. <u>Paint systems.</u> Titanium does not require a paint system for corrosion protection. Where organic finishes are required for decorative or other purposes, finishing systems may be found in TM 55–1500–345–23, aircraft maintenance manuals, overhaul manuals, or parts drawings.

D–8. CHEMICAL CORROSION REMOVAL AND TREATMENT OF PLATED AND PHOSPHATED SURFACES. Chemical corrosion removal is recommended for use where there is no danger of the chemicals becoming trapped in crevices or recesses. Acid–type chemical rust removers are recommended. The acid type is intended for removing red rust and other types of corrosion from the base metal by brush application of the chemical. The acid rust remover is intended for use following removal of heavy corrosion by mechanical means. The acid will remove any remaining corrosion and condition the metal surface to improve paint adhesion.

D–8.1. <u>Touch–up of corroded areas on cadmium or zinc plated surfaces.</u> Cadmium and zinc plate provide cathodic protection to the underlying base metal. If, during normal use, the plated surface is broken, the cadmium or zinc plate will be anodic to the base metal (usually steel or copper alloy): therefore, the plate will corrode and sacrificially protect the base metal. Removal of corrosion from cadmium or zinc plated surfaces shall be limited to the removal of the corrosion products from the underlying base metal. Mechanical corrosion removal methods shall be used.

a. Protect adjacent components for scale, corrosion products, and chemical agents.

b. Clean the area with dry cleaning solvent (P–D–680, Type II) or other material to remove grease or other soils (see Chapter 3).

c. Remove corrosion products from the base metal with abrasive paper or abrasive nylon pad. Avoid removing undamaged cadmium or zinc plate adjacent to the corroded area. Corrosion removal shall be limited to the immediate area of the corrosion on the base metal.

d. Remove any remaining corrosion and condition the metal surface with phosphoric acid base rust remover (MIL–C–10578). Allow the acid to contact the surface only long enough to remove the corrosion.

e. Allow the area to dry, and immediately apply final protective paint or other corrosion preventive finish.

NOTE

The above procedures are intended only for touchup of corroded areas on cadmium or zinc plated surfaces. Where service temperatures preclude the use of organic finishes or the thickness of the organic finish will impair operation of the part, severely corroded parts must be replaced. Where facilities are available, severely corroded cadmium plated parts may be replated.

f. Small corroded areas can be brush plated in accordance with instructions in Depot Maintenance Work Requirements (DMWR's).

D–8.2. Touch–up of corroded areas on plated Darts (except those plated with cadmium or zinc). When a break occurs in the surface of plates such as chromium, nickel, tin, or copper, corrosion of the base metal will follow. The corrosion will normally be accelerated because the above plates are cathodic to most base metals.

a. Protect adjacent components from scale, corrosion products, and chemical agents.

b. Clean the area to remove grease or other soil.

c. Remove heavy corrosion by mechanical means, such as wire brushing.

d. Remove any remaining corrosion and condition the metal surface with phosphoric acid base rust remover (MIL–G–10578). Allow the acid to contact the surface only long enough to remove the corrosion.

e. Thoroughly rinse the acid from the surface with clean water.

f. Allow the area to dry and immediately apply final protective paint or other corrosion preventive finish.

D–8.3. Paint systems. Paint may be used to prevent further corrosion on plated or phosphated surfaces, provided that the part does not operate at temperatures which preclude the use of organic finishes and that the finish will not prevent the part from performing its intended function. Organic finishes shall not be used on: bearings or wearing surfaces of gears, cams, or slides; where an electrical conducting surface is required; where the reflective properties of the plates are essential, and, other areas where the finish will prevent the part from performing its intended function. Finishes consistent with the requirements for corrosion protection of the base metal should be used. Refer to TM 55 1500–345–23, the aircraft maintenance manuals, overhaul manuals, or parts drawings for specific paint systems.

SECTION III

TREATMENT OF SPECIFIC AREAS

D–9. PURPOSE. This section covers preventive and corrective procedures and materials for specific aircraft parts or areas.

D–10. CORROSION TREATMENT OF SPECIFIC TYPE TUBING.

WARNING

Do not use Specification MIL–PRF–16173 material on any oxygen line fittings. This material contains petroleum solvents which are not oxygen compatible. Explosion may occur if oxygen contacts this material and the resulting mixture is subjected to sudden pressure or impact. After installation, apply the exterior paint system to the exposed tubing, sleeve, and back portion of the B nut of these fittings.

D–10.1. No paint coating shall be applied to the interior surface of airspeed indicator tubing, oxygen tubing, or other plumbing lines. Interior and exterior surfaces of other aluminum alloy tubing shall be treated in accordance with MIL–C–5541 (MIL–C–81706), except oxygen lines which shall be treated on external surfaces only. Tubing in methylbromide or trifluorobromoethane fire extinguishing systems shall be finished with baked resin coating conforming to MIL–R–3043. The process shall be in accordance with MIL–C–5056.

D–10.2. If possible, the interior surfaces of structural aluminum alloy tubing shall be protected in accordance with the general schedule for aircraft interior surfaces. The interior surfaces of structural aluminum alloy tubing sealed by welding need not be painted on land planes. On amphibian aircraft, however, the interior of such members shall be coated with epoxy polyamide primer (MIL–P–23377) or corrosion preventive compound (MIL–C–11796, Class 3), applied through appropriately drilled holes when permitted by aircraft maintenance manuals.

D–10.3. The interior surfaces of structural magnesium alloy tubing shall be painted in accordance with the general schedule for aircraft interior magnesium surfaces. Interior surfaces of sealed structural magnesium tubing shall be coated with epoxy polyamide primer (MIL–P–23377) or corrosion preventive compound (MIL–C–11796, Class 3), applied through appropriately drilled holes when permitted by aircraft maintenance manuals.

D–10.4. The interior and exterior surfaces of copper alloy, corrosion resistant alloy (stainless steel), and heat resistant alloy tubing need not be painted except as required for protection against dissimilar metal contact.

D–10.5. The interior of structural carbon steel tubular assemblies not closed by welding shall be finished in the same manner as exterior surfaces as possible. Assemblies completely closed by welding or to which application of primer is not practicable or not effective, such as crimped–end tubing not closed by welding or tubing heat treated after assembly, shall be treated after assembly, (and heat treatment, if perform) with hot linseed oil (ASTM D260) in lieu of the zinc chromate primer coats. The liquid shall be applied by forcing it into the hollow member under pressure through holes drilled therein or by immersing the part in a bath of the liquid. For a large structure, interconnecting holes may be drilled between various members in order that the liquid will circulate. The presence of the hot material in each member may be checked by noting the increase in temperature of the member. Parts that are immersed shall be manipulated to ensure that no airpockets are formed, and the parts shall remain in the bath until all bubbling has ceased. The members shall be thoroughly drained after treatment, and all exterior surfaces shall be wiped free of oil. All access holes drilled in the members shall be closed with cadmium plated self–tapping screws or equivalent. Solder shall not be used to close the holes.

D–10.6. Aluminum tubing which is normally exposed to the combined direct action of climatic elements either during flight or on the ground shall be protected with the complete exterior paint system. Climatic elements include humidity extremes, rain, hail, snow, sleet, salt–laden air, industrial atmospheres, wind–blown sand, and dust. Tubing in areas such as wheel wells and their fairings, speed–

brakes, wing flaps, and unsheltered tubing at missile sites is categorized as exposed tubing.

a. Clean tubing in accordance with paragraph D–2.4.1.

b. Condition surface by the method outlined in D–2.4.1.

c. Apply chromate conversion coating (MIL–C–81706) to the interior and exterior surfaces; treat only the exterior surfaces of oxygen lines.

NOTE

Apply only the conversion coating if tolerances will not allow the application of the primer coat. Take precautions to exclude primer from internal tubing areas.

d. For permanent installations, apply two coats of epoxy polyamide primer (MIL–P–23377) and two coats of paint. (See TM 55–1500–345 23 for typical paint systems). The chromate conversion coating and primer shall be applied over the entire external surface of the tubing including under the sleeve. After fabrication and prior to installation, the complete exterior paint system shall be applied to all lines and fittings. Coating damaged during installation shall be retouched. Fittings that are inaccessible for inspection and refinishing as may be required in service or are so oriented that fluid can collect on or behind the fittings shall have exposed surfaces between parts sealed with a corrosion inhibitive sealing and coating compound (MIL–S–81733). After sealing, the seals and the surfaces adjacent to them shall receive the prescribed paint finish.

NOTE

Where double flares are used, such as in oxygen systems, the ends must be capped, and paint must be applied after the flaring operation to prevent coating the inside face of the flare (sealing surface) which mates with the seat of the fitting. To prevent contamination, end fittings shall not be painted until after installation on the aircraft.

e. Paint coating shall be omitted for a distance of one inch from each fitting of lines which are known to require periodic removal in service. After installation, apply MIL–C–81309, Type II water displacing corrosion preventive compound with a small brush to the unpainted portion of the tubing, the exposed part of the sleeve, and the back portion of the B nut. Do not apply to fitting threads. Allow to dry for a period of at least one hour and then coat the same area with MIL–PRF–16173, Grade 4 corrosion preventive compound.

NOTE

Use dry cleaning solvent (P–D–680, Type I) to remove the preservative coatings from fittings installed on painted tubing.

D–10.7. Often corrosion occurs on or near sleeves used under fittings on tubing. When corrosion is encountered and/or tubing is replaced, determine what type sleeve (type metal and/or plate) is installed.

D–10.8. Stainless steel tubing which is normally exposed to the direct action of climatic elements may also require an organic finish for corrosion protection. Austenitic stainless steels are particularly susceptible to pitting and/or stress corrosion cracking when exposed to combinations of salt–laden air and dust particles (metallic or nonmetallic) or other materials which can cause concentration cells to form on the stainless steel surface, Where severe deteriorating conditions cause frequent replacement of stainless steel tubing, the tubing shall be protected as follows:

a. Remove all foreign soils, oils, and grease by hand cleaning.

b. Remove corrosion products (see 5–9.1 and D–4).

c. Wipe down immediately before painting with an approved solvent cleaner.

d. Apply wash (DOD–P–15328).

e. Apply two coats of epoxy polyamide primer (MIL–P–23377).

f. Where appearance is a consideration as an alternate to step e., apply one coat of primer followed by a topcoat of the exterior coating being used in the surrounding area. Ensure that primer and topcoat are compatible (see TT 55–1500–345–23).

D–10.9. Cadmium plate may deteriorate under exposure to certain chemicals, abrasion, or environmental conditions. Until such time as the tubing can be replaced or replated, the following method of touchup will be used:

a. Clean the tubing thoroughly.

b. Mechanically remove the deteriorated cadmium and/or corrosion.

c. Wipe thoroughly with an approved solvent cleaner.

d. Apply wash (DOD–P–15328).

e. Apply two coats of epoxy MIL–P–53022 (corrosion inhibitor, lead and chromate free).

f. As an alternate to step e., apply one coat of primer followed by a topcoat to match surrounding area. Ensure that the primer and topcoat are compatible (see TM 55–1500 345–23).

D–11. CORROSION REMOVAL FROM THIN METAL. When corrosion and stains are to be removed from airframe structure skins thinner than 0.0625 inch and an abrasive method of removal is required, the following procedure applies:

a. Prepare pumice paste by mixing pumice powder (SS–P–821) and water to form a slurry. Use a clean, soft cloth such as cheesecloth to apply the paste to the stain and rub gently.

CAUTION

Do not allow metallic or corrosion particles to build up on the polishing area or polishing tool (cloth or grit paper) during polishing. Damage to this metal may result.

b. When pumice has dried to a white powder, wipe off with clean, dry, soft cloth. If corrosion products still exist (stubborn stains), use number 600 grit, wet or dry, abrasive paper and water to remove the remaining corrosion. Wipe clean with clean, dry, soft cloth.

D–12. CORROSION AND PAINT REMOVAL FROM METAL COMPONENTS REMOVED FROM AIRCRAFT. Metal components removed from aircraft (except control surfaces, precision components, and close tolerance fittings) and taken to repair shops for routine rework may be cleaned free of paint and corrosion by abrasive blasting. See Chapter 5 and the specific alloy sections for detailed information.

D–13. AIR INTAKE DUCTS – JET AIRCRAFT. Air intake ducts are fabricated from materials (usually 5000 series aluminum) which have high corrosion resistance. Certain components of these ducts may be cast aluminum or magnesium. Coating of these casting and frequent cleaning of the duct is usually sufficient to preclude attack by corrosion. Aircraft performing low level missions or take–off and landings over salt water or in highly saline atmospheres may need the ducts painted to reduce corrosion attack. Such a requirement must be determined by the operating activity. A polyurethane paint system as outlined in TM 55–1500–345–23 is recommended.

NOTE

When the history of an aircraft reveals duct cracking and rivet shear, a coating is not desirable. Painting of such ducts will make detection of failures difficult, and often impossible, without removal of the paint.

D–14. CLOSELY COILED SPRINGS. Springs that are closely coiled, preventing the application of plating to internal surfaces, shall receive two coats of MIL–P–53022 (corrosion inhibitor, lead and chromate free) or MIL–P–23377).

NOTE

These requirements do not apply to springs made of corrosion resistant steel or beryllium copper, or to springs in oil or hydraulic fluids.

D–15. CORROSION TREATMENT OF STEEL CABLES.

a. Inspect cable for damage in accordance with TM 55–1500–204–25/1 and appropriate aircraft manuals.

b. Move surface controls of the particular cable to the extremities to reveal the cable in the pulley contact, fairlead area, or drum. If the surface of the cable is corroded, relieve cable tension and carefully force the cable open by reverse twisting and visually inspect the interior.

c. Corrosion on the interior strands of the cable constitutes failure, and the cable must be replaced. If no internal corrosion is detected, remove loose external rust and corrosion with a clean, dry, coarse-weave rag or fiber brush.

d. After thorough cleaning, apply MIL-PRF-16173, Grade I corrosion preventive compound sparingly. Do not apply the material so thick that it will interfere with the operation of cables at fairleads, pulleys or grooved bell-crank areas.

SECTION IV

DECONTAMINATION PROCEDURES FOR SALT WATER AND MICROBIOLOGICAL GROWTH CONTAMINATION

D–16. GENERAL. This section describes decontamination procedures to be followed after it has been determined that a fuel system is contaminated with salt water or microbiological growth. It is extremely important that fuel system decontamination procedures be initiated as soon as possible following evidence of contamination, particularly if salt water contaminated, because serious corrosion damage to metallic components can begin within a few hours. Defueling, depuddling and purging are required as part of decontamination of the fuel system. Defueling shall be done in accordance with instructions contained in the applicable aircraft maintenance manual.

D–16.1. Components requiring special treatment. Components such as cork floats, wiring bundles, braided hose covering and capacitance type fuel quantity indicators may require special treatments which include removal and soaking in a hot cleaning solution followed by scrubbing to remove residual salt deposits and/or microbiological growth. When ultrasonic cleaning equipment is available, cleaning time can be shortened considerably.

D–16.2. Water emulsion cleaning compounds. Water emulsion cleaning compounds are specified to assist in cleaning grossly contaminated systems. Since residues from these cleaning compounds provide food for microorganisms leading to microbiological growth, it is essential that thorough fresh water rinsing follow their use.

D–17. SALT WATER CONTAMINATION. Salt water contamination of the aircraft fuel system does not necessarily result in immediate engine fuel system contamination. Therefore, fuel samples shall be obtained from the engine fuel system beginning with main filters and working downstream until the extent of salt water penetration into the fuel system can be established. If there is no evidence of salt water in the engine fuel system, the system shall be disconnected and/or blanked off to prevent possible contamination during fuel cell and aircraft plumbing system decontamination.

D–17.1. Decontamination procedures.

WARNING

Sodium dichromate crystals (O–S–595) are toxic to the skin and eyes. Chemical or splash proof goggles, rubber gloves, (MIL–G–12223), coveralls (MIL–C–2202), and a respirator (GGGM–125/1) shall be worn when handling these crystals.

CAUTION

To prevent possible damage to fuel system non–metallic components, the solution temperature shall not exceed 120_F (49_C).

Do not allow sodium dichromate solution to dry out on any metallic surface during treatment.

CAUTION

Ensure that cellulose sponges are in good condition (i.e., not coming apart or shredding) when used inside a fuel cell or tank. Also, to prevent a fire hazard, cellulose sponges and cheesecloth used for cleaning fuel cells or tanks shall be disposed of in accordance with local safety instructions.

D–17.2. To decontaminate the fuel system, proceed as follows:

a. While the fuel system is still assembled, defuel aircraft and drain remaining fuel using low point drains. Include draining the engine fuel systems, if contaminated.

b. Prepare an inhibitor solution by adding 35 to 40 pounds of sodium dichromate crystals (O–S–595) to each 50 gallons of fresh water. To improve flushing ability. use warm water {100_ to 120_F (38_ to 49_C)}, if available.

The inhibitor solution will dissolve and remove most of the residual salts, thus providing temporary corrosion protection for metallic components.

c. To treat systems by flushing, remove tank or cell access plates and removable components, as necessary, to provide maximum access to contaminated areas. Using a pump (5100–254B) and rubber hose, pump and circulate the sodium dichromate solution throughout the tanks and cells, keeping all surfaces wet for at least 30 minutes. Allow tanks and cells to drain into receptacles during this operation.

d. As soon as treatment by flushing is completed, drain all inhibitor solution from system. Immediately begin rinsing with fresh water and continue rinsing until rinse water is clear or has only a slight orange tint.

NOTE

Fuel system components contaminated with salt water that cannot be thoroughly inspected "in place" for corrosion damage shall be removed and disassembled sufficiently to establish internal conditions and for damage correction. For metering devices and other items, remove and flush with fresh water, drain, dry, and preserve internally with water displacing, corrosion preventive compound (MIL–C–81309, Type II, Class 1), tag with the notation "CONTAMINATED INTERNALLY WITH SEA WATER", and forward to the designated maintenance facility for rework.

e. As soon as possible after flushing and inhibiting treatment, open all cells and tanks by removing access plates, probes, pumps, fittings, etc., for maximum visual inspection of interior areas.

f. Remove residual fuel and sodium dichromate solution using an explosion–proof vacuum cleaner or cellulose sponges (A–A–2073) and cheesecloth (A–A–1491). For cells which are impossible to enter, use an explosion–proof vacuum cleaner or attach the cellulose sponge or cheesecloth to a wooden handle for reaching remote areas.

g. Inspect fuel cells for corrosion and evidence of microbiological growth. Treat corrosion in accordance with Chapter 8. If microbiological growth is found proceed to and comply with paragraphs 3–249 through 3–265 of TM 55–1500–204–25/1.

h. Test fuel system for leaks as outlined in paragraph 3–351.f of TM 55–1500–204–25/1.

D–18. MICROBIOLOGICAL GROWTH CONTAMINATION OF FUEL CELLS.

WARNING

Solutions containing isopropyl alcohol (TT–I–735) are flammable and shall be drained into safety containers and disposed of in accordance with local safety instructions.

CAUTION

To prevent possible damage to fuel system non–metallic components, the solution temperature shall not exceed 120_F (49_C).

a. Defuel aircraft in accordance with instructions contained in the applicable maintenance manual.

b. Remove capacitance type fuel quantity indicator probes, internal plumbing, valves. electrical wiring, float switches, etc., as necessary to gain access to all areas where salt water or microbiological growth may have collected, or where hidden corrosive attack may have occurred. Except for fuel quantity indicator probes (which shall always be removed and cleaned), the extent of further component removal shall be determined by the evidenced need for a more in–depth inspection of a component.

c. Make up a water emulsion cleaning solution by adding one part by volume of MIL–C–85704, Type I cleaning compound to nine parts of fresh water.

d. For electrical wiring, fuel quantity indicator probes, fittings, plumbing lines, and any intricate components that cannot be effectively cleaned with the water emulsion cleaning solution and scrubbing with a hog bristle brush (H–B–420), immerse in water emulsion cleaning solution for approximately one to three hours. If possible, the solution should be heated and maintained at approximately 120_F (49_C).

e. When all residues have been loosened, rinse thoroughly with water until items are clean. Drain as well as possible, rotating items to get complete draining. Place items in drying ovens maintained at 120_F (49_C) maximum for 12 hours. If ovens are not available dry by immersing items in undiluted isopropyl alcohol (TT–I–735) for approximately one minute and blow dry with clean compressed air at a pressure of no more than 10 psi. Install new fuel quantity probes if these cleaning procedures prove to be ineffective when processed probes are tested electrically in accordance with applicable maintenance instruction manuals.

NOTE

When cleaning bladder and self–sealing cells, look for evidence of cell liner porosity, deterioration, punctures, tears, etc., which may allow salt water, sodium dichromate solution or fuel to leak from the fuel cell into the airframe cavity and cavity liners. If leaks are suspected. inspect airframe cavity liners and cavities when the cell is removed for repair or replacement. If authorized repair does not require removal, disassemble and loosen cell sufficiently to examine for liquid entrapment and corrosion damage. If cavity liner or cavity is wet, remove residual fuel/water using an explosion–proof vacuum cleaner, cellulose sponges (A–A–2073), and cheesecloth (A–A–1491). Treat corrosion in accordance with Chapter 8.

f. Clean fuel cells or tanks by scrubbing contaminated areas with water emulsion cleaning solution (see paragraph D–18.c). Efficient scrub brushes may be prepared by trimming bristles of paint brushes (H–B–420) to approximately one half the normal length. Brushes may be attached to wooden handles for reaching remote areas. Thoroughly scrub all interior areas until all residues have been loosened.

g. Ensuring that lower sections of fuel cells and tanks are open to permit free drainage, thoroughly flush and rinse interior of fuel cells with fresh (warm water, if available) to remove all foreign matter and cleaning compound residues. Continue rinsing until all evidence of cleaning compound is removed or until discharge water is clear.

h. To assist in cleaning, flush fuel cells with a mixture of one part isopropyl alcohol (TT–I–735) and one part tap water. A pump (5100–254B) and extension hose may be used to apply the water/alcohol solution.

i. Flush the hidden area with the 50% water/alcohol solution. Remove residual water/alcohol solution with an explosion–proof vacuum cleaner, cellulose sponges (A–A–2073) and cheesecloth (A–A–1491). To facilitate drainage of hidden or inaccessible areas formed by bulkheads, baffles, stiffeners, etc., alter attitude of aircraft by inflating and deflating gear struts or by using jacks in accordance with applicable maintenance instructions manuals.

j. Remove all visible traces of water: alcohol solution by passing warm {120_F (49_C) maximum}, dry air through fuel cells for approximately eight to 12 hours. This can be accomplished by closing a cell except for two openings: one for entry and one for exit of hot air. The entry and exit openings should be as far apart as possible. The exit opening should be large enough to allow water and alcohol vapors to readily escape and prevent pressure buildup in fuel cells. When possible, during the last part of the drying operation, close off the exit opening and direct the drying air through the installed fuel boost and transfer pump ports to ensure adequate drying of these parts.

k. After drying, inspect fuel cells and tanks for evidence of salt crystals or remaining sodium dichromate. Remove any such residues by swabbing with sponges dampened with the 50% water: alcohol solution. Unless the deposits are so extensive that reflushing with water is needed, it will not be necessary to perform additional forced air drying.

l. Inspect for corrosion and treat all corroded areas in accordance with Chapter 8.

m. For integral type fuel cells, inspect the condition of sealants. Repair or replace, as necessary, all sealant coatings in accordance with paragraphs 3–249 through 3–265 of TM 55–1500–204–25/1.

n. Functionally check all electrical equipment in accordance with applicable maintenance instructions manuals before installation.

o. As soon as possible after cleaning, drying, and any replacing of sealant, reassemble fuel system and change all fuel filters and fuel aircraft to normal operating capacity in accordance with applicable maintenance instructions manuals. After fueling wait a minimum of four hours and then take fuel samples from the low point drains.

p. Test fuel system for leaks in accordance with paragraph 3–251.f of TM 56–1500–204–25/1.

q. A test flight or maintenance operational check in accordance with applicable aircraft maintenance manuals shall be performed following the performed maintenance.

r. Inspect fuel storage tanks and trucks for possible sources of fungus and/or water contamination.

s. To avoid future fungus contamination, use only military specification turbine fuel, which contains a biocidal agent (MIL–I–27686), or add this agent according to accepted commercial methods noted on the biocidal container when refueling with non–military fuel.

D–19. REMOVAL OF MICROBIOLOGICAL GROWTHS.

WARNING

Open all circuit breakers associated with battery power (refer to applicable maintenance manuals) prior to application of isopropyl alcohol (TT–I–735). Do not use synthetic wiping cloths with flammable solvents such as isopropyl alcohol.

Observe personal precautionary and protective measures. Use chemical or splash proof goggles and rubber gloves when working with tri–basic sodium phosphate (O–S–642). When solution is splashed into eyes, immediately flush thoroughly with water and report to dispensary.

CAUTION

The use of strong tri–basic sodium phosphate (O–S–642) is not recommended for removing paint from wood surfaces, since the solution will attack the fibers, causing swelling and discoloration.

D–19.1. Fungus growth such as mildew and mold occur on organic materials (plastic and oil), and on organic coatings (paints) or deposits on the surface of inorganic (metal and concrete) materials, particularly in damp, warm climates.

D–19.2. Microbiological growth on plastics. Since the term plastics includes compounds of different chemical compositions varying widely in chemical and physical properties, one type of plastic may be cleaned by a method which may be destructive to another type of plastic. In general, organic solvents, including petroleum solvents such as dry cleaning solvent and mineral spirits paint thinner, should not be used to clean plastics or allowed to come in contact with plastics. Plastics are cleaned by wiping with a lint–free cloth or sponge moistened with clean water or a solution of two ounces by weight of detergent (P–D–410) per gallon of water. Plastics are polished by rubbing with ground abrasive technical pumice (SS–P–821). Other cleaning methods can be used for certain types of plastics.

D–19.2.1. Acrylate and methacrylate resin plastics (plexiglas). These plastics are cleaned by washing with a solution containing one ounce of general purpose detergent (MIL–D–16791) in one gallon of water. Wipe area with a flannel cloth.

D–19.2.2. Plastic electrical insulation. Clean plastic electrical insulation by wiping with a lint–free cloth or sponge moistened with isopropyl alcohol TT–I–735).

D–19.3. Painted and unpainted metal surfaces.

D–19.3.1. Fungus growth. Fungus growth is removed from painted and unpainted metal surfaces by scrubbing with a solution of two ounces by weight of detergent (P–D–410) per gallon of water. When fungus cannot be removed from unpainted surfaces by scrubbing with detergent, mechanical removal is recommended in accordance with the Chapter 5 of this manual.

D–19.3.2. Mildew. Mildew may be produced by fungus growing on organic matter adhering to a soft paint film or on the paint oil itself. Remove mildew by scrubbing with a water solution of tribasic sodium phosphate (O–S–642).

a. A strong phosphate solution (three pounds per 10 gallons of water) is most effective, but the solution should be applied to small areas of the surface at a time, rinsed off immediately with clean water, and dried with a wiping cloth. When allowed to remain on the painted surface for several minutes, the solution will loosen the paint and may attack the wood fibers.

b. Scrubbing the surface with a mild phosphate solution (2–1/2 ounces by weight per 10 gallons of water) will not loosen the paint and is less effective in removing the mildew. Rinse the surface thoroughly to remove residue.

c. To prevent recurrence of mildew, the old paint system should be removed in accordance with TM 55–1500–345–23.

SECTION V

IDENTIFICATION OF METALS

D–20. GENERAL. The metal identification kit (FSN 6630–831–5932) will be used to determine the types of metal(s) used in the construction of aircraft. The use of this kit employs two methods of identification: (a) primary classification of metals; and (b) chemical spot analysis. See Table D–2.

NOTE

Before proceeding with test, remove paint (if present) from a one inch square area with cloth soaked in an approved compliant solvent cleaner.

D–21. PRIMARY CLASSIFICATION.

a. For a preliminary identification, compare metal strips in the kit with unknown metal on aircraft.

b. Place a magnet on a metal surface. Magnetic attraction classifies the base metal as a ferrous magnetic material (i.e., iron or steel).

D–22. CHEMICAL SPOT ANALYSIS. Chemical tests are used to identify a base metal and/or plating. If the base metal is plated and its identification is desired, the plating must be mechanically removed by abrasion before tests are made. Surrounding surface treatments of the metal will not interfere with these tests.

D–23. TESTING PROCEDURES FOR TYPES OF SURFACE TREATMENT.

D–23.1. Phosphate treatment. To confirm the presence of a phosphate treatment on steel zinc, cadmium, or aluminum, place a drop of 20% nitric acid solution on the surface and follow this with two drops of ammonium molybdate solution. If the metal surface has had a phosphate treatment, a yellow precipitate will form.

D–23.2. Chromate treatment. Surface chromate treatments on zinc, cadmium, aluminum, or magnesium are highly colored and are indicative of the application of these treatments. A bleached chromate treatment may have been applied, however, and then coated with lacquer to mask any residual iridescence for the sake of appearance. If so, visual detection of the chromate is impossible. To test for this lacquer, proceed as directed in the following paragraph.

D–23.2.1. Test for lacquer. Place a drop of concentrated sulfuric acid on the surface. If lacquer is present, the spot will rapidly turn brown with no effervescence. If lacquer is not present, the spot will not turn brown. If the metal is zinc, there will be a rapid effervescence; if cadmium, there will be no reaction.

D–23.2.2. Test for chromate film on zinc chromium. Place a drop of 5% aqueous solution of lead acetate on the surface. If the metal has been treated, the surface will show no discoloration for 10 seconds. If there is no surface treatment, an immediate dark spot will appear.

NOTE

A bleached chromate treatment is not approved because the bleaching process lowers corrosion resistance of metal.

D–24. CONTENTS OF METAL IDENTIFICATION KIT. This kit consists of metal strips (1.0 x 6.0 x 0.063 cubic inches) to be used for visual comparison and practice, and reagents to be used for performing a chemical spot analysis. Conduct the following test procedures:

Table D-2. Metal Identification Kit

Material {1}	Specification
Aluminum (7075)	QQ-A-250/12
Aluminum (7075, anodized)	QQ-A-250/12 anodized IAW MIL-A-8625, Type I
Aluminum (7076, conversion-coated)	QQ-A-250/12 conversion coated IAW MIL-C-81706 and MIL-C-5541
Aluminum (2024)	QQ-A-250/1
Copper	ASTM B 152
Copper (chromium-plated)	QQ-C-576 chromium plated IAW QQ-C-320
Copper (nickel-plated)	QQ-C-576 nickel plated IAW QQ-N-290
Copper (silver-plated)	QQ-C-576 silver plated IAW QQ-S-365
Magnesium (AZ31 B) (chromated)	AMS 4375, 4377 or 4376
Steel (AISI 1025)	MIL-S-7952
Steel (AISI 1025, phosphatized)	MIL-S-7952 phosphated IAW TT-C-490, Type I
Steel (AISI 1025, zinc-plated)	ASTM B 633
Steel (18-8) (stainless)	AMS 5901, 5517, 5518, 5902, 5519 for CRES 301 annealed, 1/4H. 1/2H, 3/4H and Full Hard, respectively AMS 5516, 5903, 5904, 5905, 5906 for CRES 302 annealed, 1/4H, 1/2H, 3/4H and Full Hard respectively AMS 5513, 5910, 5911, 5912, 5913 for CRES 304 annealed, 1/4H, 1/2H, 3/4H and Full Hard respectively AMS 5524 or 5907 for CRES 316 annealed and 1/4H, respectively

Reagents	Volume
Acetone: Technical	16 ounces
Acid, Hydrochloric: ACS 10% aqueous solution	16 ounces
Acid, Nitric: ACS 20% aqueous solution	4 ounces

Table D–2. Metal Identification Kit (Cont.)

Reagents	Volume
Acid, Sulfuric: Technical purity	2 ounces
Ammonium Hydroxide: ACS	2 ounces
Ammonium Molybdate: ACS, saturated	2 ounces
Cadmium Chloride: 10% aqueous solution	2 ounces
Cupric Chloride: 10 grams to 100cc HCL	8 ounces
Dimethylglyoxime: ACS, saturated solution in 98% alcohol (2)	4 ounces
Lead Acetate: ACS 5% aqueous solution	4 ounces
Sodium Sulfide: ACS, saturated solution	16 ounces
Sodium Hydroxide: 10% aqueous solution	8 ounces

Miscellaneous Items	Quantity
Cheesecloth (A–A–1491)	1 yard
Dropper, Medicine	6
Labels, Gummed	1
Magnet Permanent, 2 x 1/2 x 1/2 cubic inches10	1 box

{1} Metal strips will be individually packaged in polyethylene envelopes large enough for the strips to be repackaged and isolated from each other after each use. The strips will be marked by stencil showing the alloy and coating system used.

{2} Will deteriorate with age. Keep tightly closed and away from light. Reagents will be packaged in polyethylene bottles and marked appropriately.

NOTE

Where tests have been conducted, it will be necessary to remove the test chemical. neutralize the surface, and apply the original paint coating. Where plating has been removed, recoat with two coats of epoxy primer (MIL–P–23377).

D-24.1. Iron and steel. Place a drop of 10% hydrochloric acid on the metal surface. The acid will not noticeably react on iron or steel. Place a drop of sodium sulfide over the drop of hydrochloric acid. This will cause a black ring to form around a white precipitate. To confirm this test, a drop of 20% nitric acid on iron or steel will cause a black spot, and a drop of sodium sulfide over the nitric acid will cause a black precipitate. If the steel or iron has been bonderized, the spot will appear as a black ring around a white spot in both tests. This is not a test for bonderizing process.

D-24.2. Chromium. Place a drop of 10% hydrochloric acid on the metal surface, followed by a drop of concentrated sulfuric acid. If the plating is chromium, the solution will turn green within one to two minutes.

D-24.3. Zinc. Place a drop of 10% hydrochloric acid on the metal. If the metal is zinc, reaction will be rapid. A drop of sodium sulfide over the hydrochloric acid will cause a white precipitate. To confirm this test, a drop of 20% nitric acid also will cause a rapid reaction, and the addition of sodium sulfide will form a white precipitate.

D-24.4. Cadmium. Place a drop of 10% hydrochloric acid on the metal. If the plating is cadmium. there will be no noticeable reaction. The addition of a drop of sodium sulfide over the drop of acid; however, will cause a yellow ring to form around a white precipitate. To confirm this test a drop of 20% nitric acid will react with the metal but there will be no color change. A drop of sodium sulfide over the drop of acid will cause a yellow precipitate.

D-24.5. Tin. The hydrochloric acid-sodium sulfide test will have the same reaction on tin as on cadmium. If the metal is tin, a drop of 20% nitric acid on the surface will cause a rapid reaction and a black spot to form. When a drop of sodium sulfide is added to the acid, the result is a black precipitate.

D-24.6. Cadmium. Place a drop of 20% nitric acid on the surface and let it react for 10 seconds. Then add a drop of 10% hydrochloric acid. If the metal is silver, there will be an immediate formation of a white precipitate.

D-24.7. Nickel. Place a drop of dimethylglyoxime solution on the metal and follow it with a drop of ammonium hydroxide. The result will be pink-red coloration. Both the 10% hydrochloric acid-sodium sulfide and the 20% nitric acid-sodium sulfide tests will cause a black ring around a white precipitate.

D-24.8. Magnesium. A drop of 10% hydrochloric acid on magnesium will cause a violent reaction and a black spot to form. To confirm that the metal is magnesium, place a drop of 10% sodium hydroxide on the surface. There should be no reaction.

D-24.9. Aluminum. Unlike its reaction on magnesium, 10% hydrochloric acid will have no noticeable reaction on aluminum. A spot of 10% solution of sodium hydroxide (caustic soda) on the surface, however, will cause a rapid reaction.

D-24.10. Heat-treatable and nonheat-treatable aluminum alloys. Place a drop of 10% solution of sodium hydroxide (caustic soda) on the metal. Pure or nonheat-treatable aluminum will not discolor, but heat-treatable aluminum alloys will turn black.

D-24.11. Clad aluminum alloys. Clad alloys must be tested on the unclad edge. A drop of 10% cadmium chloride solution on a clean unclad surface of the metal will produce a dark discoloration on 7076 and 7178 aluminum alloys within two minutes. No discoloration will appear on 2024 aluminum alloy within two minutes.

D-24.12. Copper and brass. If plating is present, remove it by abrasion with sand-paper. Determine whether the metal is copper or brass by noting the typical brass or copper color. Similarly determine copper plating by its typical color.

D-24.13. Stainless steel (18-8). Mix 10 grams of cupric chloride in 100 milliliters of hydrochloric acid and place one drop of the mixture on the metal. After two minutes, follow this with three or four drops of water, then dry the surface. If a brown spot appears, the metal is 18-8 stainless steel.

SECTION VI

CONSUMABLE MATERIALS

Table D–3. Consumable Materials

Item	Nomenclature	Specification	NSN	QTY
1	Linseed Oil	ASTM D260	8010–00–684–8789	GL
2	Coating Compound Metal Pre–treatment	MIL–C–8514	8030–00–082–2425	GL
3	Primer, Wash	DOD–P–15328	8030–00–535–9780	OZ
4	Corrosion Removing and Metal Conditioning	MIL–C–10578	6850–00–854–7952	5 GL
5	Corrosion Removing Compound	MS–36429	6850–00–935–5853	
6	Sulfuric Acid	O–S–809	6810–00–227–1845	80 OZ
7	Hydrofluoric Acid	MIL–A–24641	6810–00–543–4012	GL
8	Sodium Dichromate	O–S–595	6810–00–262–8566	5 LB
9	Resin Coating	MIL–R–3043	8030–00–200–6946	GL
10	Corrosion Preventive Compound	MIL–C–11796	8030–00–231–2353	5 LB
11	Corrosion Removal Compound	MIL–C–38334	6850–00–527–2426	5 GL
12	Brush Platers. Hard Swab	H–B–178/1–2	7920–00–244–7431	
13	Chromium Trioxide, Technical Grade	O–C–303	6810–00–882–4997	LB
14	Corrosion Inhibitor, Lead and Chromate Free	MIL–P–53022	8010–00–082–1714	GL
15	Sponge	A–A–2073	7920–00 633–9908	EA
16	Brush, Paint	H–B–420	8020–00–200–3489	EA
17	Washing Compound	P–D–410	7930–00–880–4454	GL
18	Technical Pumice	SS–P–821	5350–00–161–9034	LB
19	Tribasic Sodium Phosphate	O–S–642	6810–00–141–6080	LB
20	Inhibitor, Icing, Fuel	MIL–I–27686	6850–01–016–1914 6850–00–753–5061 6850–00–060–5312 6850–00–082–2522	14 OZ 5 GL 55 GL BULK
21	Aqueous Cleaning Solutions	HURRISAFE 9050 or 9060	Open Purchase, PCI of America	GL

APPENDIX E
(FOR AIR FORCE USE ONLY)

SUPPLEMENTARY REQUIREMENT FOR AIR FORCE AIRCRAFT

This appendix consists of ten sections. Section I contains supplementary requirements which apply to cleaning of Air Force aircraft, in addition to the basic text of this manual. Section II covers procedures for shot peening and/or roto-peening of metals when required by system peculiar aircraft corrosion manuals and/or other directives. Sections II through IX cover chemical corrosion removal procedures. Section X contains tables of corrosion control equipment and materials.

SECTION I

SUPPLEMENTARY CLEANING REQUIREMENTS

NOTE

MIL–C–87937, Type II cleaner is authorized as a substitute for MIL–C–85570 cleaner for all Air Force cleaning operations.

E–1. WHEN WORK WILL BE ACCOMPLISHED. Cleaning and related treatments shall be accomplished as frequently as prescribed in this appendix, or more frequently whenever inspection indicates that the work is required. Areas of missiles unprotected from elements (e.g., rain, dust, snow, etc.) shall be inspected daily. Aircraft wash cycle requirements shall be established by the Aircraft System Program Manager and the using command in conjunction with the Air Force Corrosion Program Office. The commander shall provide a definite schedule for the inspection, cleaning, and corrosion treatment of assigned aircraft and missiles.

NOTE

Aircraft and missiles in storage should be inspected for preservation and cleaning as required.

E–1.1. Frequency. The frequency of inspection, cleaning, and related treatment of aircraft and missiles will depend upon the types of items which are assigned and environmental and other conditions. Table E–1 specifies the required wash interval by base for assigned weapon systems when not otherwise specified in system peculiar technical orders. These intervals were determined from environmental and pollution data for each base. The following are guidelines indicating need for cleaning and possible related treatment.

a. Aircraft and equipment soiled with fire extinguishing materials shall be cleaned as soon as possible after exposure. At no time shall fire extinguishing residue, such as that resulting from the use of bromochloromethane type or foam type fire extinguishing materials, be allowed to remain on the equipment for a period exceeding four hours. If the aircraft or equipment is impounded as a direct result of an accident, the accident investigation board shall consider the corrosive action of the fire extinguishing material and release the aircraft for removal of this material immediately or at the earliest possible time consistent with the accident investigation. Prompt action in accomplishing and/or complying with this procedure can result in the saving of considerable manhours and materials in salvaging or restoring the equipment to serviceable status (see Chapter 9 of this manual for removal instructions).

b. Areas around batteries require close attention and shall be cleaned and treated regularly. Spilled electrolyte shall be removed immediately and affected areas shall be cleaned and treated.

c. Aircraft and missiles transported via salt water shall be cleaned and given related treatment after receipt. This is especially applicable if package and preservation materials are damaged.

d. Aircraft are required to be rinsed with clear water when exposed to a salt water environment. Specific rinse requirements are as follows:

(1) All aircraft at bases located within 1.25 miles (2 km) of salt water shall be rinsed with clear water at least once every 15 days if not washed.

(2) All aircraft deployed to a location within 1.25 miles (2 km) of salt water for ten days or more are considered to have the same requirements as are those in 1. When the rinse cannot be accomplished at the off station location, due to mission requirements and/or facility limitations, and entry will be placed in the aircraft forms and a clear water rinse will be accomplished within three days of return to the home station. When the rinse cannot be accomplished off station and the aircraft remains deployed for 30 days or more, the aircraft shall be washed within three days after return to the home station.

Table E–1. Aircraft Wash Intervals

NOTE

For those bases which are required to accomplish a clear water rinse every 15 days in accordance with Paragraph E–1.1., subparagraph d., a waiver from the 30 day wash interval to 45 days may be requested, through the Command Corrosion Program Manager, to Air Force Corrosion Program office. Waivers will only be granted when it has been satisfactorily shown that adequate capability exists for accomplishing timely clear water rinsing for assigned aircraft. Plans and scheduling will track the 15–day rinse cycle by entering a special inspection into their maintenance data system for assigned aircraft. This is to ensure the rinse program is tracked as scheduled maintenance and not solely in the aircraft AFTO Forms 781k.

Air Base Name and Location	Wash Interval By Severity: Severe (30 Days)	Moderate (90 Days)	Mild (120 Days)
Aj Taif, SA			X
Al Jouf, SA			X
Allen C. Thompson Fld.; Jackson, MS			X
Al Kharij AB, SA		X	
Altus AFB, OK (AETC)			X
As Sulayyil, SA			X
Anderson AFB, GU	X		
Anchorage IAP, AK (ANG)			X
Andrews AFB, MD (Wash. DC)			X
Atlantic City, NJ (ANG)			X
Aviano AB, IT	X		
Bahrain		X	
Bangor IAP, ME (ANG)			X
Barksdale AFB, Shreveport, LA			X
Barnes, M. Apt.; Westfield, MA (ANG)			X
Battle Creek, MI (ANG)			X
Beale AFB, Marysville, CA			X
Birmingham Apt., AL (ANG)			X
Boise Air Term., ID (ANG)			X
Bradley IAP; Windsor Locks, CT (ANG)			X
Brindisi/Casale AB, IT	X		
Buckley ANGB; Denver, CO			X
Burlington IAP, VT (ANG)			X
Byrd Field, VA (ANG)			X
Cannon AFB; Clovis, NM			X
Capital Mun. Apt.; Springfield, IL (ANG)			X
Carswell AFB; Fort Worth, TX			X
Channel Islands Apt., CA (ANG)	X		
Cheyenne Apt., WY (ANG)			X
Charleston AFB, SC			X
Columbus AFB, MS (AETC)			X
Davis–Monthan AFB; Tucson, AZ			X
Des Moines IAP, IA (ANG)			X

Table E–1. Aircraft Wash Intervals (Cont.)

Air Base Name and Location	Wash Interval By Severity Severe (30 Days)	Moderate (90 Days)	Mild (120 Days)
Dhahran, SA			X
Diego Garcia	X		
Dobbins AFRB; Marietta, GA (AFRC)		X	
Douglas IAP; Charlotte, NC (ANG)			X
Dover AFB, DE			X
Duluth IAP, MN (ANG)			X
Dyess AFB; Abilene, TX			X
Eareckson (Shemya) AFB, Aleutian Is., AK	X		
East WV R. Apt./Shep. Fld.; Martinsburg, WV (ANG)			X
Edwards AFB; Rosamond, CA			X
Eglin AFB, Valparaiso, FL		X	
Eglin AFB (Aux Field #3), FL			X
Eielson AFB, AK			X
Ellington Fld.; Houston, TX (ANG)			X
Ellsworth AFB; Rapid City, SD			X
Elmendorf AFB; Anchorage, AK			X
Fairchild AFB; Spokane, WA			X
Fairford, UK			X
Falcon AFB, CO			X
Forbes Fld., KS			X
Fort Smith Mun. Apt., AR			X
Francis E. Warren AFB; Cheyenne, WY			X
Fresno Air Term., CA (ANG)			X
Geilenkhirchen, GE		X	
Gen. Mitchell IAP; Milwaukee, WI (A)			X
Grand Forks AFB; Emarado, ND			X
Great Falls IAP, MT			X
Greater Peoria Apt., IL			X
Griffiss AFB; Rome, NY			X
Grisson ARB; Peru, IN (AFRC)			X
Hancock IAP; Syracuse, NY (ANG)			X
Hanscomb AFB; Bedford, MA			X
Harrisburg IAP, PA (ANG)			X
Hector IAP; Fargo, ND (ANG)			X
Hickam AFB; Honolulu, HI	X		
Hill AFB; Ogden, UT			X
Holloman AFB; Alamogordo, NM			X
Homestead ARB, FL (AFRC)			X
Howard AB, Panama		X	
Hulman Reg. Apt., IN (ANG)			X
Hurburt Fld.; Fort Walton Beach, FL		X	
Incirlik AB, Turkey		X	
Jacksonville IAP, FL			X

Table E–1. Aircraft Wash Intervals (Cont.)

Air Base Name and Location	Wash Interval By Severity Severe (30 Days)	Moderate (90 Days)	Mild (120 Days)
Jeddah, SA			X
Joe Foss Field; Sioux Falls, SD (ANG)			X
Kadena AB, Japan	X		
Keesler AFB; Biloxi, MS	X		
Kelly AFB; San Antonio, TX			X
Key Fld.; Meridian, MS (ANG)			X
Khamis Mushay, SA		X	
King Khalid, SA			X
Kingsley Fld.; Klamoth Falls IAP, OR			X
Kirtland AFB, NM; Albuquerque, NM			X
Kunsan AB; S. Korea	X		
Lajes Fld; Azores, Portugal	X		
Langley AFB; Hampton, VA		X	
Laughlin AFB; Del Rio, TX			X
Lincoln Mun. Apt., NE (ANG)			X
Little Rock AFB, AR (AETC)			X
Luke AFB; Glendale, AZ			X
MacDill AFB; Tampa, FL	X		
Malmstrom AFB; Great Falls, MT			X
Mansfield Lahm Apt., OH			X
March ARB; Riverside, CA (AFRC)			X
Martin St. Apt.; Baltimore, MD			X
Maxwell AFB; Montgomery, AL			X
McChord AFB; Tacoma, WA			X
McClellan AFB; Sacramento, CA			X
McConnell AFB; Witchita, KS			X
McEntire ANGB; Columbia, SC (ANG)			X
McGhee Tyson Apt.; Alcoa, TN			X
McGuire AFB; Wrightstown, NJ			X
Memphis IAP, TN (ANG)			X
Minot AFB, ND			X
Minn.–St.Paul IAP, MN (AFRC)			X
Misawa AB, Japan		X	
Moffett Fld., CA			X
Moody AFB; Valdosta, GA (AETC)			X
Mountain Home AFB; Boise, ID			X
NAS Keflavic, Iceland	X		
NAS New Orleans, LA			X
Nashville Met. Apt., TN (ANG)			X
Nellis AFB; Las Vegas, NV			X
Newburgh Apt., NY			X
New Castle Co. Apt.; Wilmington, DE			X
Niagara Falls Int. Apt., NY (AFRC)			X

Table E–1. Aircraft Wash Intervals (Cont.)

Air Base Name and Location	Severe (30 Days)	Wash Interval By Severity Moderate (90 Days)	Mild (120 Days)
Offutt AFB; Omaha, NE			X
O'Hare IAP; Chicago, IL (AFRC)			X
Osan AB, S. Korea		X	
Otis ANGB; Falmouth, MA (ANG)			X
Patrick AFB; Cocoa Beach, FL	X		
Pease ANGB; Portsmouth, NH (ANG)		X	
Peterson AFB; Colorado Springs, CO			X
Pittsburgh IAP, PA (AFRC)			X
Pope AFB; Fayetteville, NC			X
Portland IAP, OR (ANG)			X
Prince Sulan AB, SA			X
Puerto Rico IAP/Muniz ANGB; San Juan, PR		X	
Quonset St. Apt.; Providence, RI (ANG)	X		
RAF Lakenheath, UK		X	
RAF Mildenhall, UK		X	
Ramstein AB, GE			X
Randolph AFB; San Antonio, TX (AETC)			X
Reese AFB; Lubbock, TX (AETC)			X
Reno/Tahoe IAP, NV (ANG)			X
Rhein–Main, GE	X		
Richards–Gebauer AFRB, MO (AFRC)			X
Rickenbacker IAP; Columbus, OH (ANG)			X
Riyadh, SA			X
Robins AFB; Warner Robins, GA			X
Rosescrans Mem. Apt.; St. Joseph, MO (ANG)			X
Schenectady Co. Apt., NY (ANG)			X
Scott AFB; Belleville, IL			X
Selfridge ANGB; Mount Clemens, MI (ANG)			X
Seymore Johnson AFB; Goldsboro, NC			X
Shaw AFB; Sumpter, SC			X
Sheppard AFB; Wichita Falls, TX (AETC)			X
Sioux Gateway Apt.; Sioux City, IA (ANG)			X
Spangdalhem AB, GE			X
Spokane IAP, WA (ANG)			X
Springfield–Bleckley Mun. Apt., OH			X
Standiford Fld./Lvle. IAP; Louisville, KY (ANG)			X
Suffolk Co. Apt., NY (ANG)		X	
Tabuk, SA			X
Taegu, S. Korea			X
Tinker AFB; Oklahoma City, OK			X
Toledo Exp. Apt.; Swanton, OH (ANG)			X
Travis AFB; Fairfield, CA			X
Travis Fld.; Savannah, GA (ANG)		X	

Table E-1. Aircraft Wash Intervals (Cont.)

Air Base Name and Location	Severe (30 Days)	Wash Interval By Severity Moderate (90 Days)	Mild (120 Days)
Truax Fld./Dane City Reg. Apt.; Madison, WI (ANG)			X
Tulsa IAP, OK (ANG)			X
Tyndall AFB; Panama City, FL	X		
Van Nuys Apt., CA (ANG)			X
Vance AFB; Enid, OK (AETC)			X
Vandenburg AFB; Lompoc, CA			X
Volk Fld.; Madison, Wl (ANG)			X
Westover AFB; Chicopee, MA (AFRC)			X
Whiteman AFB; Knobnoster, MO			X
Willow Grove ARS; Philadelphia, PA (AFRC)			X
Wright-Patterson AFB; Dayton, OH			X
Yeager Apt.; Charleston, WV			X
Yokota AB, Japan			X
Youngstown-Warren Reg. Apt. ARS, OH (AFRC)			X

NOTE

When extremely unique operational requirements or facility limitations severely impact a unit's ability to accomplish daily rinses, the MAJCOM corrosion program manager, in conjunction with the aircraft system program manager, may temporarily waive the daily rinse requirement. All waivers must be forwarded through the MAJCOM corrosion program manager to the Aircraft System Program Manager, who has final approval authority. The MAJCOM corrosion Program Manager must forward a copy of the approved waiver to the Airforce Corrosion Program Office. Each waiver shall be valid for a period not to exceed one year.

(3) A clear water rinse is required after the last flight of the day when a low level flight (under 3,000 feet) over salt water has occurred. The same rinse requirement exists when two or more take-offs and landings that require low level flight over salt water are performed in a single day. (Touch-and-go landings or low level approaches generate the same rinse requirements as full-stop landings.)

e. Aircraft which perform only a single takeoff and/or landing requiring low level flight over salt water in one day are excluded from clear water rinses except when this occurs five or more times in a 15 day period. After the fifth occurrence in a 15 day period, an entry will be made in the aircraft forms for a clear water rinse to be accomplished within three days.

f. Bases that must routinely rinse assigned aircraft, due to low level flight over salt water, may adopt a 15-day rinse program for all assigned aircraft in lieu of routine daily rinsing of flyers. This option will not be granted for aircraft based within 1.25 miles of salt water or involved in search/rescue/recovery or other special operations over salt water. Approval for adoption of the 15-day rinse program must be requested through Major Command Corrosion Program Manager to the Airforce Corrosion Program Office. Bases granted the 15-day rinse program will ensure Plans and Scheduling enters a special inspection into their maintenance data system. This is to ensure the rinse program is tracked as scheduled maintenance and not solely in the aircraft AFTO Forms 781K.

g. Procedures for decontamination of radioactive aircraft and missiles are in the 00-110A-series technical orders.

Table E–2. MIL–C–87937

Nomenclature	Specification/ Part Number	National Stock Number	Unit of Issue	Intended Use
		Cleaning Compound		
Cleaning Compound, Aircraft Exterior	MIL–C–87937B Type I	6850–01–390–7808 6850–01–390–7811 6850–01–390–7816 6850–01–390–7821	1 Gallon 5 Gallon 55 Gallon Bulk	Terpene based, solvent emulsion, water diluteable cleaning compound. Best used on heavily soiled areas on painted and unpainted surfaces where sufficient ventilation is available. Depending on dilution ratio, may be used for general aircraft cleaning. Suitable for use on high gloss or tactical paint systems.
	Type II	6850–01–390–7827 6850–01–339–5227 6850–01–339–5228 6850–01–390–7828	1 Gallon 5 Gallon 55 Gallon Bulk	Water diluteable cleaning compound. Best used for general aircraft cleaning on painted or unpainted surfaces. Suitable for use on high gloss or tactical paint systems.
	Type III	6850–01–390–9530 6850–01–390–9453 6850–01–390–9558	1 Gallon 55 Gallon Bulk	Gel–type (thixotropic, viscous) cleaning compound. Best suited for use on heavily soiled surfaces, painted or unpainted, where additional dwell time is desired (i.e., wheel and flap wells overhead and vertical surfaces). Should be used in areas that can tolerate high–volume water rinsing.
	Type IV	6850–01–429–2368 6850–01–429–2371	1 Gallon 55 Gallon	Heavy duty, water diluteable cleaning compound. Equally suited for cleaning both heavily soiled areas and general aircraft surfaces; may be used on painted or unpainted surfaces. Suitable for use on high gloss or tactical painted systems.

h. Procedures for neutralization of corrosive chemicals are in AFM 71–4 AFTO form 781A will be annotated for all corrosive chemical spills.

E–2. ALTERNATE CLEANERS. Alternate aircraft cleaning compounds (refer to Table E–2) for Air Force use include the following:

a. MIL–C–87937, Type I. This is a biodegradable, terpene based cleaner for limited use in certain applications. This cleaner may be used in place of MIL–C–85570 (Type I or II) when approved by the system manager for the particular type system or equipment. It is authorized for support equipment (See T.O. 35–1–3) and landing gears (See T.O. 4W–1–61). It is also approved for a limited number of aircraft by the respective system managers. Refer to the specific system –23 T.O. for technical data, authorizations, precautions and limitations. For heavily soiled areas, use 1 part cleaner to 4 parts water. For lightly soiled areas, use 1 part cleaner to 20 parts water.

b. MIL–C–87937, Type II. This cleaner is intended for medium to light cleaning of aircraft, the exterior of engines, and aerospace ground equipment (AGE). It can be used as an alternate or replacement for MIL–C–87936 Type I for all surfaces, except it shall not be used for cleaning plastic type canopies without the authorization of air craft system manager. Normal dilution is 1 part to 10 parts with water. However, it can be diluted 4 parts to 10 parts water for spot cleaning. Follow the procedures in paragraph E–3 for cleaning aircraft. Although not a solvent, use as a wipe solvent substitute. Hand wipe in accordance with the following:

(1) Medium grease removal – dilute MIL–C–87937 Type II with water to make a 20% solution (1 part cleaner : 4 parts water). Use a clean, dry, lint free cloth for the final wipe.

(2) Light grease removal – dilute MIL–C–87937 Type II with water to make a 10% solution (1 part cleaner : 9 parts water). Use a clean, dry, lint free cloth for the final wipe.

c. MIL–C–87937, Type III. This is a gel cleaner intended for light to heavy duty removal of greases, oils, hydraulic fluid, and carbon in wheel wells and wing butts. It can be used on most areas where complete rinsing with water can be tolerated, and is used full strength. Completely rinse this material off with water after use. Do not use for cleaning plastic canopies.

NOTE

Large–scale use of the bulk form of this cleaner in aircraft wash facilities may lead to problems at waste–water treatment facilities.

d. MIL–C–87937, Type IV. This is a heavy duty water dilutable cleaning compound intended for light to heavy duty removal of greases, oils, hydraulic fluid, and carbon. Normal dilution is 1 part to 10 parts with water. However, it may be diluted 4 parts to 10 parts water for spot cleaning. Follow the procedures in paragraph E–3 for cleaning aircraft. It shall not be used for cleaning plastic type canopies.

e. MIL–C–43616. This is a solvent emulsion cleaner which is very effective at removing oily soils and greases. The aerosol version of this cleaner (6850–00–005–5305) is especially effective as a spot cleaner. Since this cleaner has a very high solvent content it is NOT recommended for use on non–polyurethane paints.

E–3. CLEANING METHOD (AIR FORCE PREFERRED).

WARNING

Wear rubber gloves. chemical or splash proof goggles, and water resistant boots during cleaning operations using cleaning compound. Wet weather clothing is not required except during cold weather. If cleaner is splashed in eyes, rinse thoroughly with fresh water for 15 minutes and report to medical facility. Remove clothing saturated with cleaning solution immediately and flush exposed skin areas with fresh water.

Open all circuit breakers associated with battery power (refer to applicable aircraft manuals) prior to application of flammable solvents.

CAUTION

Do not use abrasive mats (A–A–58054) for cleaning painted surfaces.

a. Rinse aircraft surfaces where necessary to reduce skin temperature. Streaking will occur if cleaning solutions drip down hot painted surfaces.

b. Apply diluted cleaning compound from a bucket, spraying equipment, or foaming equipment (see 3–4.1 and 3–4.2) and scrub surfaces with aircraft washing kit No. 251 fitted with a cleaning pad or sponge (see Figure 3–5) or with a cleaning brush. To prevent streaking, start at the lower surfaces, working upward and out (see Figure 3–4).

c. Rinse away the loosened soil and cleaner with fresh water. For rinsing, a rubber–padded shut–off spray nozzle is recommended (see Figure 3–6). Rinse the cleaner and loosened soil from aircraft surface with a fan spray nozzle, directed at an angle between 15 and 30 degrees from the surface. Continue rinsing until all evidence of cleaner and soils have been removed from aircraft.

d. See Table 3–1 for instructions on specific areas and components.

CAUTION

Due to the very high potential for water intrusion into bearings and other critical areas, this high–pressure/hot water wash equipment shall not be used to wash landing gear, wheels or brake components while these items are installed on the aircraft.

E–4. HIGH PRESSURE/HOT WATER WASH EQUIPMENT. The high pressure/hot water wash equipment is used for general purpose cleaning of aircraft, aerospace ground equipment and vehicles. The operating procedure is as follows:

a. Use only Air Force approved cleaners for the cleaning compound.

b. Set the cleaning compound/water mixture ration to 50 : 1.

c. Use only 40 degree flat fan spray nozzles.

d. The stand–off distance from aircraft to nozzle must never be less than twelve inches.

e. The unit will deliver approximately four gallons per minute nozzle, an operating pressure of 3000 pounds per square inch, and water temperature of 210_F.

NOTE

The pressure and temperature at the end of the nozzle may not be the same due to length of the hoses.

This equipment may cause paint and/or sealant to come loose.

E–5. CLEANING METHODS – MISSILES.

WARNING

When hand cleaning using alkaline or solvent emulsion cleaners, precautions shall be taken for personal protection. Wear chemical or splash proof goggles, and rubber gloves as a minimum.

When using cleaning solvents wear chemical or splash proof goggles, rubber gloves, a wet weather suit, and protective boot covers. Consult the local safety officer and bioenvironmental engineer for specific instructions.

E–5.1. General cleaning of all exterior missile surfaces shall be accomplished using MIL–C–87937, Type II cleaning solutions. Surfaces which have been treated with corrosion preventive compounds shall be cleaned with dry cleaning solvent (P–D–680, Type II or III), followed by MIL–C–87937, Type II cleaning solutions, if required. The cleaning solution shall be applied by hand using clean cloths, sponges, or a nonmetallic bristle brush.

E–5.2. Alkaline and solvent emulsion cleaning.

a. Prepare the area to be cleaned by masking all areas where the cleaning solution may be trapped or accumulated and cannot be dried, or will damage missile components (i.e. pod doors, areas around thrust rings, electrical fixtures, radomes, optical glass nirdomes, etc.).

b. Inspect to determine that all access to interior components and compartments are in place or sealed.

c. Cleaning operations shall be accomplished in planned steps to obtain the most satisfactory results. Begin hand cleaning at the highest surface to be cleaned.

d. Contamination on painted and unpainted surfaces shall be removed by applying a cleaning solution of either MIL–C–87937, Type II or MIL–C–85570 in accordance with Chapter 3 of this manual. The maximum solution ratio authorized shall be used for hard–to–remove soils.

e. The solution shall be applied and the surface rubbed by hand with clean sponges.

f. The solution shall be rinsed from the surface before allowing it to dry, using warm water {approximately 140_F (60_C)}. Apply the rinse water (preferably deionized or distilled) using clean cloths or sponges which are frequently rinsed. The final rinse of the surface shall be accomplished with deionized or distilled water. When it has been determined that surfaces are clean, dry all areas completely with clean cloth or sponges. Particular attention shall be given to areas where water could be trapped.

E–5.3. Specific cleaning requirements.

a. Surfaces of missiles which have been protected with corrosion preventive compound can be cleaned with P–D–680, Type II or III as below. An alternate method is to use MIL–C–87937 in accordance with paragraph E2 if it is certain that the cleaner or water will not seep into areas where it will cause damage due to poor drainage. If MIL–C–87937 is used, the surfaces must immediately be rinsed thoroughly with water to prevent corrosion damage.

b. For other surfaces, painted or unpainted, use dry cleaning solvent (P–D–680, Type II or III). Follow the safety procedures and application guidelines in Chapter 3 of this manual.

c. If the surface is not clean after applying the solvent cleaner, reclean the surface as prescribed above prior to reapplying the corrosion preventive compound.

d. Equipment used for Air Force cleaning operations is listed in Table E–3.

E–6. LOW TEMPERATURE AIRCRAFT SURFACE CLEANING. Routine scheduled cleaning should not be performed at temperatures below 40_F (4_C). When outside temperatures are below 40_F (4_C), the aircraft should be cleaned in an indoor wash rack. If an indoor wash rack is not available and the aircraft cannot be flown to a warmer climate, routine scheduled cleaning will be delayed until the temperature rises above 40_F (4_C). However, any aircraft surface contaminated by corrosive materials (e.g., runway anti–icing fluid, salt water, etc.) will be cleaned even if the temperature is below 40_F (4_C) in accordance with the following procedures.

E–6.1. Cleaning procedure. Refer to paragraph 3–5.3.9.

E–7. TREATMENT AND DISPOSAL OF WASH RACK WASTE.

E–7.1. Precautionary measures shall be taken to prevent wash rack waste from contaminating lakes and streams. Some of the chemical utilized for cleaning require treatment or other special control prior to disposal.

E–7.2. Disposal of wash rack waste shall be accomplished in accordance with applicable Federal/State/Local directives.

E–8. SOIL BARRIERS.

E–8.1. Materials. Cee–Bee A–6 and Eldorado PC–1020 are extremely effective in preventing damage to paint systems in engine exhaust track areas. Cee–Bee A–6 is also effective on both painted and unpainted areas of the aircraft subjected to gun gas residue. It is applied after washing and is easily removed with dry cleaning solvent (P–D–680, Type II or III), followed by alkaline water base cleaner (MIL–C–87937, Type II).

E–8.2. Application.

WARNING

Provide adequate ventilation when using dry cleaning solvent (P–D–680, Type II or III). Avoid prolonged breathing of vapors and skin contact. Use protective gloves, apron, chemical or splash proof goggles, and, if required by the local bioenvironmental engineer, respiratory protection.

NOTE

The soil barrier is not adversely affected by rain or clear water, but it is degraded by alkaline or solvent emulsion cleaning compounds. Do not attempt to wash a surface protected with a soil barrier with alkaline or solvent emulsion cleaners unless reapplication of the soil barrier is intended.

The temperature of surfaces to be treated should be below 100_F (38_C). If the temperature exceeds 100_F (38_C), cool the surface with a light spray of water before applying the soil barrier.

a. Thoroughly preclean the surface to be protected, using either alkaline cleaner (MIL–C–87937, Type II). For mixing instructions, see E–2 and Chapter 3.

b. Rinse the surface thoroughly to insure removal of all grease, soil, and cleaner. Allow rinse water to drain from the surface.

c. When most of the water has drained from the surface, apply a uniform film of undiluted soil barrier material (Cee–Bee A–6 or Eldorado PC–1020), with non–atomizing spray equipment, brush, or roller, or by a dip technique.

d. Immediately flush application equipment with clear water. If the material dries on equipment. remove with dry cleaning solvent (P–D–680, Type II or III) or by soaking in a solution containing one part of alkaline cleaner (MIL–C–87937, Type II) in three parts of water.

E–8.3. Removal. While surfaces protected with Cee–Bee A–6 are in service, traffic soil will gradually accumulate on the surface of the soil barrier. When the soil accumulation exceeds acceptable appearance limits, or when it is time for routine maintenance, follow the following procedure.

a. Apply dry cleaning solvent (P–D–680, Type II or III) with a brush, mop, or non–atomizing spray equipment.

b. Allow the solvent to dwell on the surface until it penetrates the soil and soil barrier.

c. Wash the area with either one part alkaline cleaner (MIL–C–87937, Type II) in three parts water and thoroughly flush the surface with a flowing water rinse. Cee–Bee A276 or Eldorado Astromat A may be used as an alternate material for removing Cee–Bee A–6 and Eldorado PC–1020 (soil barrier), NSN and unit of issue same as "Cee–Bee A–6", from aircraft exhaust paths only. They shall not be used for any other type of aircraft cleaning. These materials may be used as received or diluted with one part water; undiluted materials usually give better results. They can be applied with a mop or brush or by spray.

d. Allow the material to dwell on the surface for 20 to 60 minutes, or until it penetrates the soil barrier, and then thoroughly flush the surface with water.

e. After allowing most of the rinse water to drain from the surface, reapply Cee–Bee A–6 or Eldorado PC–1020 to the surface.

E–9. INTEGRAL FUEL TANKS.

E–9.1. Soils, contaminants, and a brown slimy residue formed by bacteria growths have been noted in the integral fuel tanks of some aircraft in the past. This condition resulted in the deterioration of some coating and sealing compounds and caused pitting beneath the deposits which advanced to intergranular exfoliation of aluminum components in lower area of the tanks. Inspection for and cleaning of contamination in integral fuel tanks is important to prevent this type of corrosion.

E–9.2. Procedures for removal of surface contamination and corrosion products from integral fuel tanks.

WARNING

Tanks which have contained fuel are hazardous until all fumes and residual fuel deposits have been removed. They are potential explosion hazards, and health hazards, and shall be treated as such. This corrosion removal and treatment is NOT for oxygen tanks.

NOTE

Procedures outlined shall be only after tanks have been thoroughly flushed, contain no fuel, and are essentially vapor free. Procedures shall be accomplished under control and direction of applicable regulations, ground safety officer, fire marshall, etc. The responsible people shall be certain that all measures prescribed by T.O. 1–1–3, T.O. 00–25–172, and T.O. 00–25–235 are observed.

a. Prior to entry into tanks, they shall be drained, purged, opened, depuddled, dried, and properly ventilated by authorized fuel cell personnel in accordance with T.O. 1–1–3.

b. When the tanks are dry and adequately ventilated, enter and conduct a preliminary inspection in accordance with procedures outlined in T.O. 1–1–3 for any of the following:

(1) Solid or gummy residues.

(2) Black scaly areas indicative of surface corrosion.

(3) Pitting corrosion or blisters.

(4) Loose areas of topcoat.

(5) Loose sealant.

Table E-3 Aircraft Cleaning Equipment

Item	Specification	NSN	Unit Issue
Aircraft Cleaning Kit		7920-00-490-6046	Kit
Barrier Material	MIL-PRF-131, Class I	8135-00-282-0565	200 yd roll
Boot Covers, Chemical		8430-01-021-5978 8430-01-118-8172	Pair (large) Pair (small)
Boot, Firemen's	MIL-B-2885	8430-00-753-6105	Pair
Boot, Overshoe	MIL-O-836	8430-00-144-1648	Pair
Brush, Cleaning	H-B-531, Type I MIL-B-23958 Intex Model 241	7920-00-240-7171 7920-00-054-7768 7920-01-089-9077	Each Each Each
Bucket, Rubber, 3GL		7240-01-150-0716	Each
Cleaning Pads, Non-metallic	A-A-3100 Type I Type II	7920-00-151-6120 7920-00-171-1534	Package Package
Cloth, Cotton	A-A-2522	7020-0205-1711	50 lb bale
Foam Generator		4940-01-041-5680	Each
Gloves, Rubber	Obtain from: DuBarry Gloves 443 Park Avenue New York, NY 10016 Plasco Company P.O. Box 367 Springfield, OH 45501	NSN's have not been established for these gloves	
Goggles, Chemical	ANSI Z87.1 Alternate sources: Lab Safety Supply Part No. A883F P.O. Box 1368 Janesville,WI 53547-1368 H.L. Bouton Part No. 551 P.O. Box G 320 Main Street Buzzards Bay, MA 02532		Pair
Handle, Brush		7920-00-141-5452	Each
Sponge, Synthetic	A-A-2073	7920-00-633-9915	Each

Table E–3. Aircraft Cleaning Equipment (Cont.)

Item	Specification	NSN	Unit Issue
Sprayer, Insecticide		3740–00–641–4719	Each
Suit, Wet Weather	MIL–P–43907	8405–01–853–9202 8405–01–053–9400	Each (parka) Each (trousers)
Tape, Masking Pressure sensitive, Non–staining	MIL–T–21595, Type III	7510–01–158–6603 7510–01–158–6604 7510–01–158–6607	Roll (2”) Roll (1.5”) Roll (3”)
Wiping Cloths		7920–01–180–0556 7920–01–180–0557	Box (9” x 9”) Box (17” x 21”)

CAUTION

If inspection reveals that cleaning is required, protect bottom of tank with heavy paper or rubberized canvas covered foam rubber pads.

c. If tanks are free of conditions noted in step b. above, inspect and close tanks in accordance with T.O. 1–1–3 and applicable aircraft manuals.

d. If any of the conditions noted in step b. above exist, accomplish the following:

(1) Clean tank interior surfaces which are treated in accordance with this manual.

(2) Remove Specification MIL–C–2772 fuel coating in areas where contamination/deposits were found by abrading it away with Specification A–A–58054, Type 1, Grade C, abrasive mat or 120–280 grit aluminum oxide or silicone carbide abrasive paper or cloth. Continue removal in all directions from the contaminated area, until certain that the full extent of noted corrosion is within the stripped area.

WARNING

Polyurethane is flammable and highly toxic to skin, eyes, and respiratory tract. Chemical or splash proof goggles and rubber gloves are required. Avoid all contact. Exhaust ventilation is required for work in enclosed space. Keep open flames and other ignition sources away from area.

(3) Remove any faulty sealant brush coat and/or fillet seals in accordance with instructions contained in T.O. 1–1–3. It is important that all loose sealant be removed and replaced since it could be the cause of future leakage or be the starting point for continued growth of contamination causing recurrence of corrosion. Replace all faulty sealant found and overcoat with Specification MIL–C–83019 clear flexible polyurethane coating per T.O. 1–1–3.

NOTE

Do not use plastic or metal scrapers to remove defective sealant. (See T.O. 1–1–3 for proper tools.)

(4) Inspect bare areas closely for indications of pitting or surface blistering. In any cavity (a bay between two adjacent inspar ribs) where pits are found, a thorough investigation will be conducted in that cavity. Remove coating in adjacent areas on ribs or spars until traces of pitting or blistering are no longer evident. Pitting is usually indicated in coated areas by the deteriorated appearance of the coating. Corrosion may also be evident where contamination has entered through pin holes in the coating and caused a buildup of corrosion products. Surface blistering of aluminum is readily visible through the coating, as it is transparent.

E–9.3. Removal of corrosion and rework of pitted areas of tanks. Complete removal of corrosion products is required to prevent recurrence of corrosion in the affected area.

WARNING

Power abrasive removal operations create airborne particles. Eye protection is required. Good general ventilation is normally adequate.

a. Remove corrosion by mechanical methods in Section V using materials listed in this manual for aluminum. Abrasive blasting, however, shall not be used. Generally, power driven abrasive on a flexible shaft are the most effective means of corrosion removal in this area. Corrosion removal shall be followed by hand sanding with 280 grit paper or cloth followed by 400 grit paper or cloth abrasive to produce a smooth surface finish. The aircraft –3 and –23 manuals shall be consulted to assure structural limits are not exceeded.

WARNING

To prevent injury to personnel, exercise caution when using sharp or pointed tools.

b. After sanding operations, clean abrasive residue off reworked areas, using a clean cloth, and inspect for small shiny patches which appear much brighter than the basic metal. These generally indicate that exfoliation exists underneath the exposed shiny surface below a blister from which the top has been partially removed. As the surface is being sanded during rework, these blisters (being high points) receive most of the abrasive action, leaving the blister area much brighter than the base material. In order to completely remove the corrosion, these skin blisters must be removed to fully expose the powdery corrosion deposits underneath. It will usually be much faster and easier to pry the top off the blister with a sharp instrument. This operation requires extreme caution to prevent unnecessary gouges or scratches in the basic material. Pitted and exfoliated areas must be reworked to a depth sufficient to remove all the corrosion and the resulting depression must be blended into the surrounding surface. All loosened material must be removed from fuel tank prior to further treatment.

c. Abrade the reworked area to remove the oxide film which forms on it and the surface of the Specification MIL–C–27725 fuel tank coating adjacent to the reworked area to remove the gloss from it with Specification A–A–58054, Type 1, Grade A abrasive mat.

WARNING

A–A–59281 solvent is flammable and toxic to skin, eyes, and respiratory tract. Chemical or splash proof goggles and rubber gloves are required. Respirators may be required in enclosed area.

d. Clean the area thoroughly to remove all residue, oil, and grease with a clean lint free cloth wetted with Specification A–A–59281 solvent. Do not allow solvent to dry by evaporation; wipe the area dry with a clean cloth to prevent redisposition of soils on the surface.

WARNING

PR–148 is flammable and toxic to skin, eyes, and respiratory tract. Chemical or splash proof goggles and rubber gloves are required. Respirators may be required in enclosed areas.

e. Apply MIL–C–5541/MIL–C–81706, Class 1A, conversion coating to the reworked area in accordance with this manual.

f. Apply PR–148 (Products Research and Chemical Co.) adhesion promoter to the reworked area and the dulled area of the coating around the area and allow to dry for 30 minutes minimum.

WARNING

MIL–PRF–81733 sealant is moderately toxic to skin and body, if ingested. Wear gloves to avoid contact. Wash hands thoroughly after use before eating, drinking, or smoking.

g. Using an acid brush which has had the bristles clipped off to half their original length, scrub Specification MIL–PRF–81733, Types I or II sealant onto the reworked area to make sure the sealant wets the entire area and overlaps on the dulled area of the coating around the area slightly. Add more sealant with the brush until a slight mound is formed and smooth the surface with the brush.

h. Replace any fillet or brush coat sealant removed to facilitate rework of a corroded area per instructions in T.O. 1–1–3.

i. When sealant applied in steps g. and h. above is tack free, overcoat the sealant with a Specification MIL–C–83019 clear flexible polyurethane coating.

E–9.4. Aluminum external fuel tanks/drop tanks.

WARNING

Tanks which have contained fuel are hazardous until all vapors and residual fuel deposits have been removed. They are potential explosion and health hazards and should be treated as such. This corrosion removal and treatment procedure is NOT for oxygen tanks.

E–9.5. Exterior tank surface. If painted, remove paint from area where corrosion is suspected per instructions in T.O. 1–1–8 such that a margin of good metal around the suspected area is exposed.

a. Remove and treat corrosion in accordance with this manual.

b. Apply MIL–C–5541/MIL–C–81706, Class 1A conversion coating to bare metal area in accordance with this manual.

c. Touch up area from which paint was removed per T.O. 1–1–4 and –23 aircraft Technical Orders using procedures in T.O. 1–1–8.

E–9.6. Interior tank surface. The interior surface of aluminum alloy tanks shall not be painted. If a preservative mixture is present, remove it only from the immediate area requiring corrosion removal and treatment. Dilute MIL–C–87937 Type II to make a 10% to 20% solution. Apply cleaner solution with a sponge, soft brush, or cloth. Scrub area to thoroughly remove preservative and rinse with fresh water. Use a clean, dry, lint free cloth for the final wipe.

a. Remove and treat corrosion in accordance with this manual.

b. Apply MIL–G–5541/MIL–C–81706, Class IA conversion coating to bare metal area in accordance with this manual.

c. Per T.O. 00–85A–03–1, preserve the interior of assembled tanks by fogging with or apply with lint free clean cloth soaked in preservative consisting of one part of compound (MIL–C–6529, Type 1) and three parts of oil, (MIL–L–6081, Grade 1010) introduced by means of a pressure spray to provide complete atomization. The tank shall be vented at the farthest practicable distance from the introduction point of the oil during spraying operations. The amount of preservative shall be a minimum of 0.12cc per square foot of internal surface area.

NOTE

Tanks containing foam baffling shall not be preserved. Preservative compound is compatible with gasoline and jet type fuels, and need not be removed before placing tank in service.

E–10. REMOVAL OF FUNGUS GROWTHS.

E–10.1. Fungus growth such as mildew and mold occur on organic materials (plastics, oil, etc.) and on organic coatings (paints) or deposits on the surface of inorganic (metal, concrete, etc.) materials, particularly in damp, warm climates.

WARNING

Mixture (50–50) of alcohol and water is flammable (flash point 60_F). Use with adequate ventilation and comply with guidelines cited in Chapter 3 for solvent cleaning.

E–10.2. Removal of fungus from Plastics. Since the term plastics include compounds of different chemical compositions, varying widely in chemical and physical properties, one type of plastic may be cleaned by a method which may be destructive to another type of plastic. In general, organic solvents and mineral spirits paint thinner, should not be used to clean plastics or allowed to come in contact with plastics. Plastics shall be cleaned by wiping with a lint–free cloth or sponge moistened with clean water or a solution of isopropyl alcohol (TT–I–735, Grade A) and tap water mixed 50–50 with two (2) ounces by weight per gallon of detergent, (P–D–410, Type II) added. Plastics shall be polished by rubbing with ground abrasive technical pumice (SS–P–821). Other cleaning methods can be used for certain types of plastics.

WARNING

Aliphatic naphtha is flammable and toxic to eyes, skin, and respiratory tract. Avoid skin and eye contact. Good general ventilation is normally adequate. Keep away from open flames or other sources of ignition.

a. Acrylate and methacrylate resin plastics (plexiglas) shall be cleaned by washing with aliphatic naphtha (TT–N–95). Aromatic naphtha shall not be used since it attacks the plastic.

(1) Apply the naphtha with a lint–free cloth or sponge.

b. Plastic electrical insulation shall be cleaned by wiping with a lint–free cloth or sponge moistened with clean water or a solution of isopropyl alcohol (TT–I–735, Grade A).

E–10.3. Removal of fungus from metal surfaces. Fungus can be removed from metal surfaces with alkaline water cleaner and by other standard cleaning methods.

E–10.4. Removal of fungus from electrical connectors. The fungus shall be removed with isopropyl alcohol (TT–I–735).

a. Pins (male contacts) shall be cleaned by wiping with a clean, lint–free cloth moistened with isopropyl alcohol (TT–I–735).

b. Receiver holes (female contacts) shall be cleaned with a toothpick or pipe cleaner saturated with isopropyl alcohol (TT–I–735).

NOTE

Fungus removal in most cases can be accomplished by normal cleaning operations.

SECTION II

SHOT PEENING/ROTO–PEENING

E–11. PEENING OF METAL SURFACES.

WARNING

Peening operations create airborne particles. Eye protection and adequate ventilation are required.

E–11.1. Peening is a special form of abrasive blasting which slightly deforms the metal surface by dimpling it, producing a compressive stress on the metal surface. It acts as a preload stress which must be exceeded by tensile loads applied to a part before the metal surface experiences any tensile stress due to the applied tensile load. The deformation on the surface tends to close off the exposed ends of metal grains and boundaries on the metal surface. The compressive stress on the surface increases the resistance of the metal to fatigue and stress corrosion cracking, because both begin on the surface of the metal when it is subjected to tensile stresses. The closure of exposed end grains and grain boundaries increases the resistance of the metal to intergranular corrosion; in particular, it increases the resistance of high strength aluminum alloys to exfoliation corrosion. Because of the increased resistance to corrosion and fatigue afforded by peening, this process is now being specified for numerous new protection steel and aluminum alloy parts and is being required as a final procedure during corrosion rework and grindout in areas reworked for corrosion damage at both field and depot levels of maintenance on many aircraft components. Peening will not recover the strength lost in a metal structure caused by metal removal due to corrosion damage, but it will increase the resistance of the remaining metal to corrosion and fatigue. Peening requires the use of larger sized abrasive particles than used in abrasive blasting operations, special procedures for accomplishment, and special techniques and equipment for measuring the intensity of peening (degree of peening measured with an Almen gage) and end saturation of peening (surface coverage of peening determined with a 10X magnifying glass).

NOTE

Peening is a specialized process requiring specialized training in the techniques used. Personnel who have not been specifically trained for peening operations and who are not thoroughly familiar with the specifications and standards which cover these operations (MIL–STD–852, MIL–S–13165, MIL–R–81841, and MIL–W–81840) shall not be allowed to perform peening operations. Damage to structure, injury to personnel, ineffective peening, and a false sense of security about the condition of peened aircraft structure will result if untrained and inexperienced personnel are allowed to perform peening operations.

E–11.2. Types of peening.

WARNING

Peening can cause injury to personnel, as high speed abrasive particles can strike unprotected areas of the body and slippage can occur on abrasive residue buildup on the floor. Damage to equipment can result from abrasive particles which enter working mechanisms.

Personnel shall wear protective goggles or a faceshield, in addition to gloves and other clothing as required when engaged in peening operations. The work area shall be kept clean of abrasive residue buildup. Masking and shielding materials shall be used to prevent penetration of abrasive particles in areas adjacent to the area being peened and to contain the abrasive overspray.

E–11.3. There are three basic types of peening used on Air Force equipment: shot peening, per MIL–S–13165; glass bead peening, per MIL–STD–852; and, roto–peening, per MIL–R–81841. A description of each of these types is presented below.

E–11.3.1. Shot Peening. Shot peening, per MIL–S–13165, is the peening of a metal surface by direction an air driven stream of abrasive particles onto the metal surface, using the same type of equipment as is employed for abrasive blasting to remove corrosion. The materials used are: CRES steel wire particles, per ASTM A 580 or ASTM A 313; steel grit, cut wire shot, and iron grit and shot, per MIL–S–851; and, glass beads, per AMS 2431. Specification MIL–S–13165 should be consulted for all parameters concerning shot peening, such as intensity, saturation points, angle of blasting, nozzle distance, dwell times, pressures, and shot, wire, and bead sizes.

NOTE

Do not use peening media (i.e., shot and glass beads) used for previously peening one type of metal to peen a different type of metal, as contamination of the metal surface and subsequent galvanic corrosion will result. Do not use any steel wire or shot for peening aluminum alloy surfaces, as steel particles will become embedded and cause galvanic corrosion; use AMS 2431 glass beads only, MIL–STD–852 is the primary method for the peening of aluminum alloys.

E–11.3.2. Glass bead peening. Glass bead peening, per MIL–STD–852, is the peening of a metal surface by directing an air driven stream of glass beads, conforming to AMS 2431, onto the metal surface, using the same type of equipment as is employed for abrasive blasting to remove corrosion. AMS 2431 should be consulted for all parameters concerning glass bead peening, such as intensity, saturation points, angle of blasting, nozzle distance, dwell time, pressures, and bead sizes.

E–11.3.3. Roto–peening. Roto–peening, per MIL–R–81841, is the peening of a metal surface using fiber type flaps, with metal particles bonded to them, mounted in a mandrel and rotated in a pneumatic drill motor. The flaps are held close to the metal surface while the drill motor is moved linearly along the surface, such that the metal shot bonded to the flap strike the surface; this causes the peening action on the surface over the entire area being peened. Flaps used for roto–peening conform to MIL–W–81840, Type I (rigid core with bonded flaps, with MIL–S–851 cast steel shot bonded to the flaps) and Type II (flap assembly mounted in a slotted mandrel with tungsten carbide shot bonded to the flap). MIL–R–81841 should be consulted for all parameters concerning roto–peening, such as intensity, saturation points, flap distance from surface, linear movement rate of flap, dwell times, drill motor speed (in rpm), and size of flap. This method of peening is convenient for peening small areas where corrosion rework has been accomplished on the aircraft, since it does not produce the contamination and abrasive residue associated with the airblast methods.

NOTE

MIL–W–81840, Type I flaps shall not be used to peen aluminum surfaces, since they contain cast steel shot which can become imbedded in the surface and cause galvanic corrosion. Use only Type II flaps on aluminum surfaces.

E–11.4. Rotary flap peening. Roto–peening is the primary peening process to be used after corrosion treatment and repair of aircraft components. For this reason, only procedures for roto–peening are given in this manual as part of the corrosion treatment repair. These procedures are limited in their scope of application and will not be used for any purpose other than the peening or repeening of aircraft components after corrosion removal. Furthermore, the amount of peening that may be accomplished is limited as follows:

a. An area no greater than three inches by four inches square will be peened.

b. When more than one area on a component must be peened, the cumulative size of these areas will not exceed three inches by four inches square.

c. This procedure is not authorized for peening to accomplish fatigue or stress relief on previously unpeened areas where corrosion removal is not involved.

d. Any peening operation which exceeds these parameters will be accomplished in accordance with MIL–R–81841 instead of these procedures.

e. Rotary peening will only be accomplished when required in weapon system technical orders or the component is identified as having been peened.

Table E–4. Tool Operation Speed Requirements

Tool (MIL–W–81840)	Tool Description	Operation on Speed (RPM) Normal Range	Operation on Speed (RPM) Maximum Allowed
Type I	Rigid Core Cast Steel Shot	1500 to 4000	4500
Type II, Class 1	Mandrel with 2 x 1" flaps	1500 to 5000	6000
Type II, Class 2	Mandrel with 1–1/4 x 9/16" flaps	2750 to 7000	14000
Type II, Class 3	Mandrel with 1 x 9/16" flaps	2750 to 7000	14000

E–11.4.1. Rotary flap Peening Procedures.

WARNING

Rotary flap peening operations create airborne particles; eye protection, therefore, is required.

E–11.4.1.1. Equipment. The tools required for rotary peening are: pneumatic drill or high speed grinder; flap wheel, conforming to MIL–W–81840; air regulator, for drill or grinder; and, tachometer. The pneumatic drill or high speed grinder must be capable of achieving the rpm required for the type of peening wheel or flap being used (within plus or minus 100 rpm under load); see Table E–4. The speed must be checked with the tachometer. The air regulator is used for adjusting the air pressure for the control of the rpm. MIL–W–81840 flap wheels are of two types: Type I wheels are for use on ferrous metals, and Type II wheels are for use on aluminum.

E–11.4.1.2. Preparation Procedure.

a. Dimensions and conditions of parts. Areas of parts to be peened shall be within dimensional and surface finish requirements before peening. Except as otherwise directed, all heat treatments performed to meet requirements for mechanical properties, and all machining, grinding, and required polishing of areas shall be completed before peening. All fillets shall be properly formed, all burrs shall be removed, and all sharp edges and corners to be peened shall be provided with sufficient radii to result in complete coverage without any distortion prior to peening.

b. Cleaning and stripping. Unless otherwise specified, all areas shall be cleaned in accordance with this manual. Procedures for stripping coatings can be found in T.O. 1–1–8.

c. Masking. Any areas of the part which have critical surface finishes that must be free from peening shall be suitably masked or otherwise handled to protect such surfaces from the rotary flapping action or subsequent damage. Masking shall be optional for areas not requiring peening and whose surface finishes are not critical.

E–11.4.1.3. Determining Peening Intensity. The peening intensity is a measure of the amount of compressive stress applied to the surface of the metal component being peened. This is measured as an arc–height value, which is based on the fact that a sheet of metal which is cold worked on one side only will deform, due to the compressive stresses set up on the cold worked side, and will form a bow or arc. The height of the arc is measured in inches and is determined using an Almen test strip. The peening intensity required after corrosion removal will be that which is specified in the weapon system technical order or may be determined from Table E–5. The peening intensities given in this table are for standard shot peening and were determined with an Almen test strip in accordance with MIL–S–13165. These must be converted to rotary peening intensities in accordance with MIL–R–81840, using the graph in Figure E–1.

Table E–5. Peening Intensity for Complete Coverage (Arc–Height Inches) {1} {2}

Material Thickness (In.)	Steel: Under 20000 PSI	Steel: Over 20000 PSI	Titanium and Titanium Alloys	Aluminum and Aluminum Alloys
0.090 or less	0.003–0.0006A	0.003–0.006A	0.003–0.006A	
0.0090 0.375	0.006–0.012A	0.006–0.010A	0.006–00.010A	0.0060–0.010A
0.375 or more	0.012–0.016A	0.006–0.010A	0.006–0.010A	0.010–0.014A

(1) Base on stripholder specified in MIL–S–13165.

(2) The suffix letter A indicates that the values have been determined by the use of the test strip A. Test strip A is used for arc heights up to 0.024A. For greater intensity, test strip C should be used. Test strip N is used if the intensity is less than 0.004A.

E–11.4.1.4. Determining rpm and peening time. The required peening intensity determined from Table E–5 and converted in Figure E–1 will be used in Figures E–2 and E–3 to establish peening time and rpm requirements. Figure E–2 converts peening intensity to the rpm and peening time required to achieve the peening intensity when using Type I peening wheels. Figure E–3 accomplishes the conversion for Type II, Class 1, 2, and 3 peening wheels. The peening times have been determined by saturating the 2.25 square inch test strip at the rpm and times given in Figures E–2 and E–3 to obtain the corresponding peening intensity. For areas smaller or larger than 2.25 square inches, the following equation will be used to determine peening time:

$$T = T_S A / A_S$$

T = total peening time, in minutes

T_S = saturation peening time, as determined from Figures E–2 and E–3, in minutes

A = area of part to be peened in square inches

A_S = 2.25 square inches, used in test strip (when flap width of 3/4 inch or less is used; if flap width Is greater than 3/4 inch multiply effective flap width by 3 inches to obtain A_S)

Example – for a 3 inch by 4 inch area of 0.090 to 0.375 inch width aluminum, using Type II, Class 2 material:

T = (3.6 x 12)/2.25 = 43.2/2.25
= 19.2 min = 19 min 12 sec

NOTE

MIL–W–81840, Type I flaps shall not be used to peen aluminum surfaces, since they contain cast steel shot which can become imbedded in the surface and cause galvanic corrosion. Use only Type II flaps on aluminum surfaces.

E–11.4.1.5. Peening Process. To achieve the required peening intensity, the flap wheel must be operated at the required speed under load. The flap wheel shall be moved over the surface being peened with longitudinal sweeps and transverse oscillation to provide uniform surface coverage. Sufficient hand pressure shall be applied to the tool to deflect the flaps, as shown in Figure E–1. This will be done over the entire surface of the area to be peened for the time which was determined in E–11.4.1.4. It is essential that proper flap deflection be maintained throughout the peening process.

NOTE

The flaps used for this procedure are expensive and tear apart easily when they drop over the edge of a part during the peening operation. The use of a hard rubber material clamped in place at the edges of the part being peened will prevent the flaps from dropping over the edge of the part during the peening operation, thus increasing the useful life of each flap.

E–11.4.1.6. Peened coverage. Peened areas shall be visually inspected with a 10X power magnifier for complete coverage. Every portion of the critical surface shall show visible evidence of plastic flow to indicate complete coverage and obliteration of the original surface finish, as indicated by overlapping peening impressions.

E–11.4.1.7. Surface finish. Conversion coat or passivate the peened area in accordance with the applicable section of this manual. Apply protective coatings in accordance with T.O. 1–1–8.

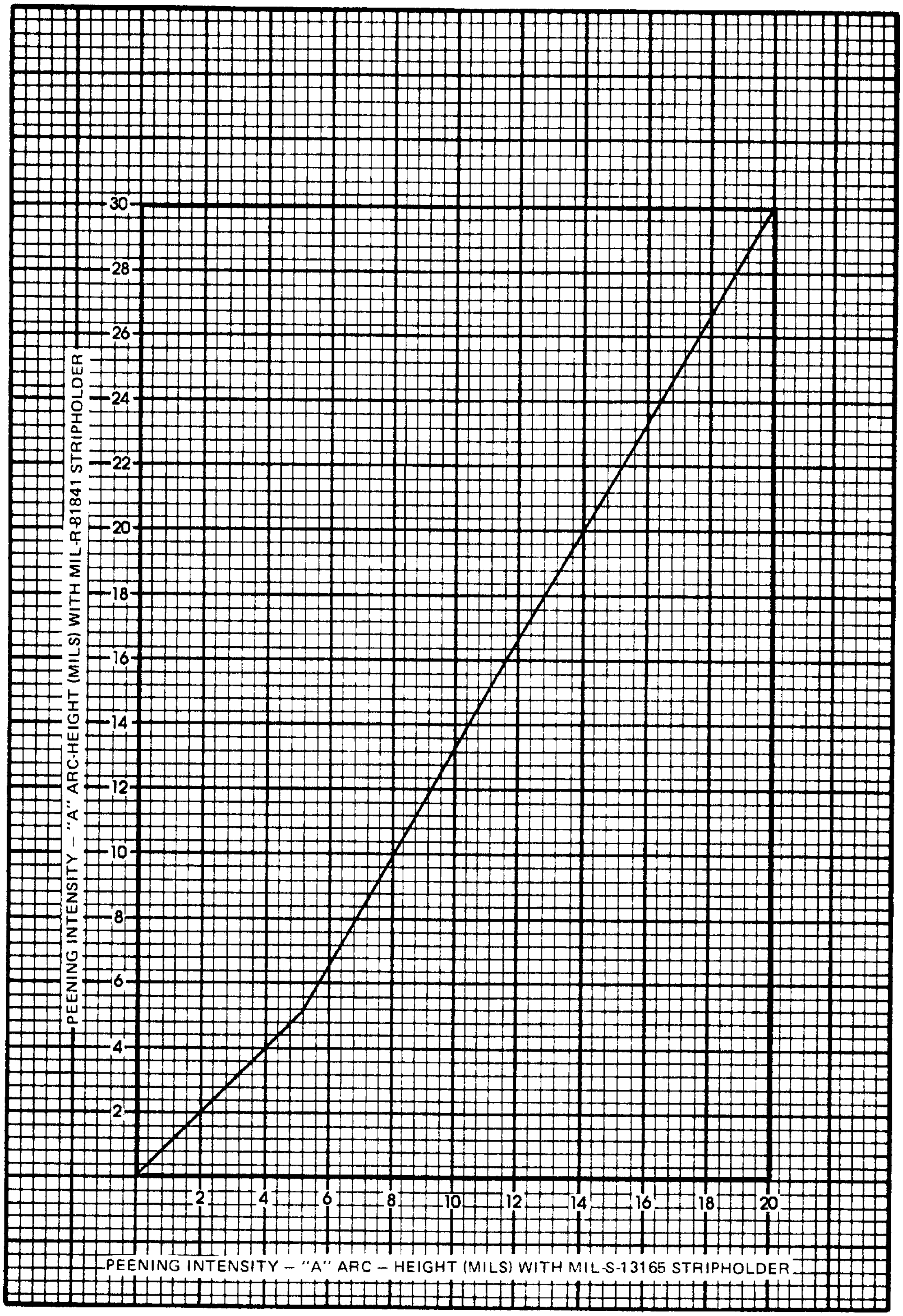


Figure E-1. Peening Intensity Conversion Curve

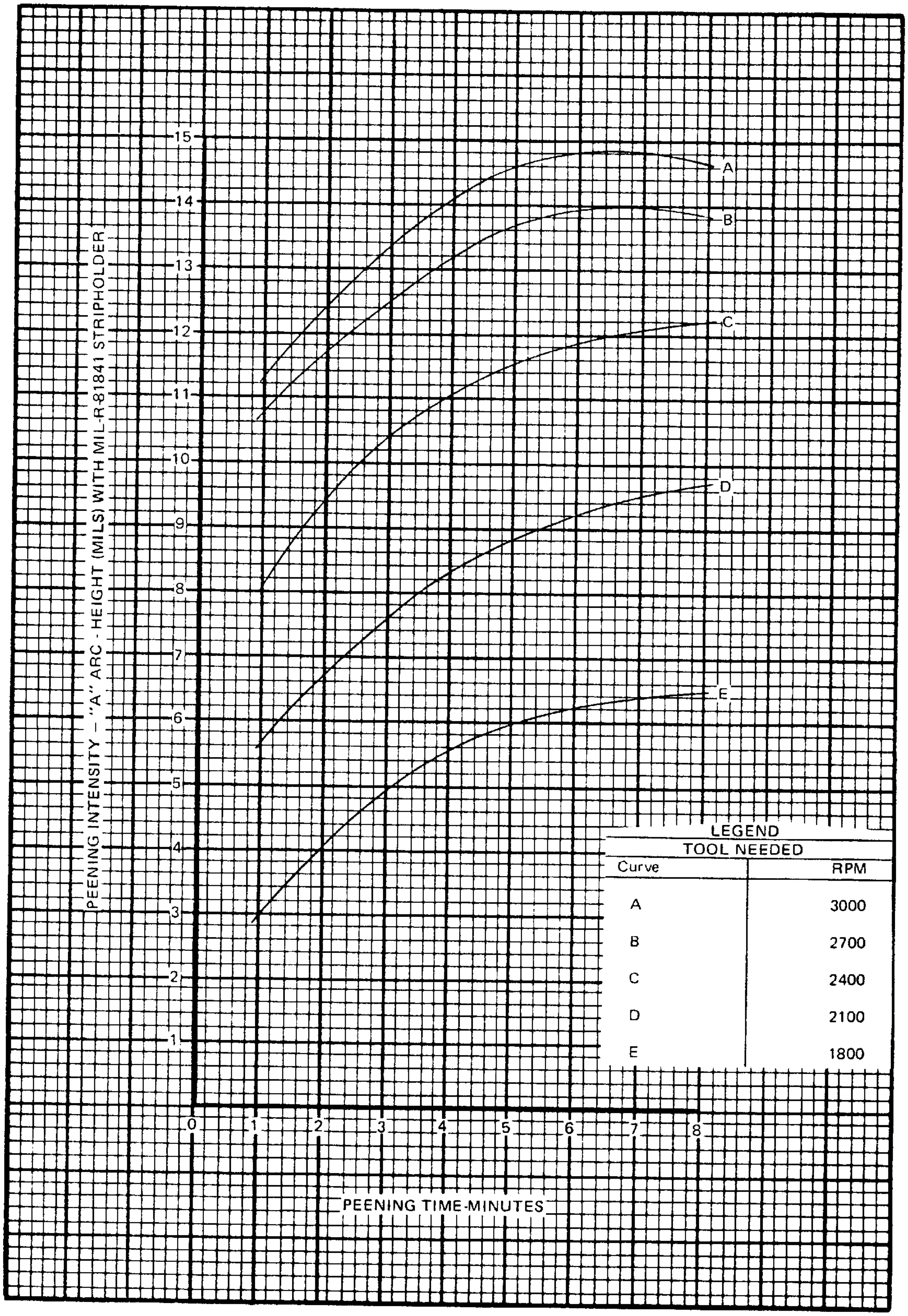


Figure E-2. Saturation Coverage Curves for Type I Wheels of MIL-W-81840

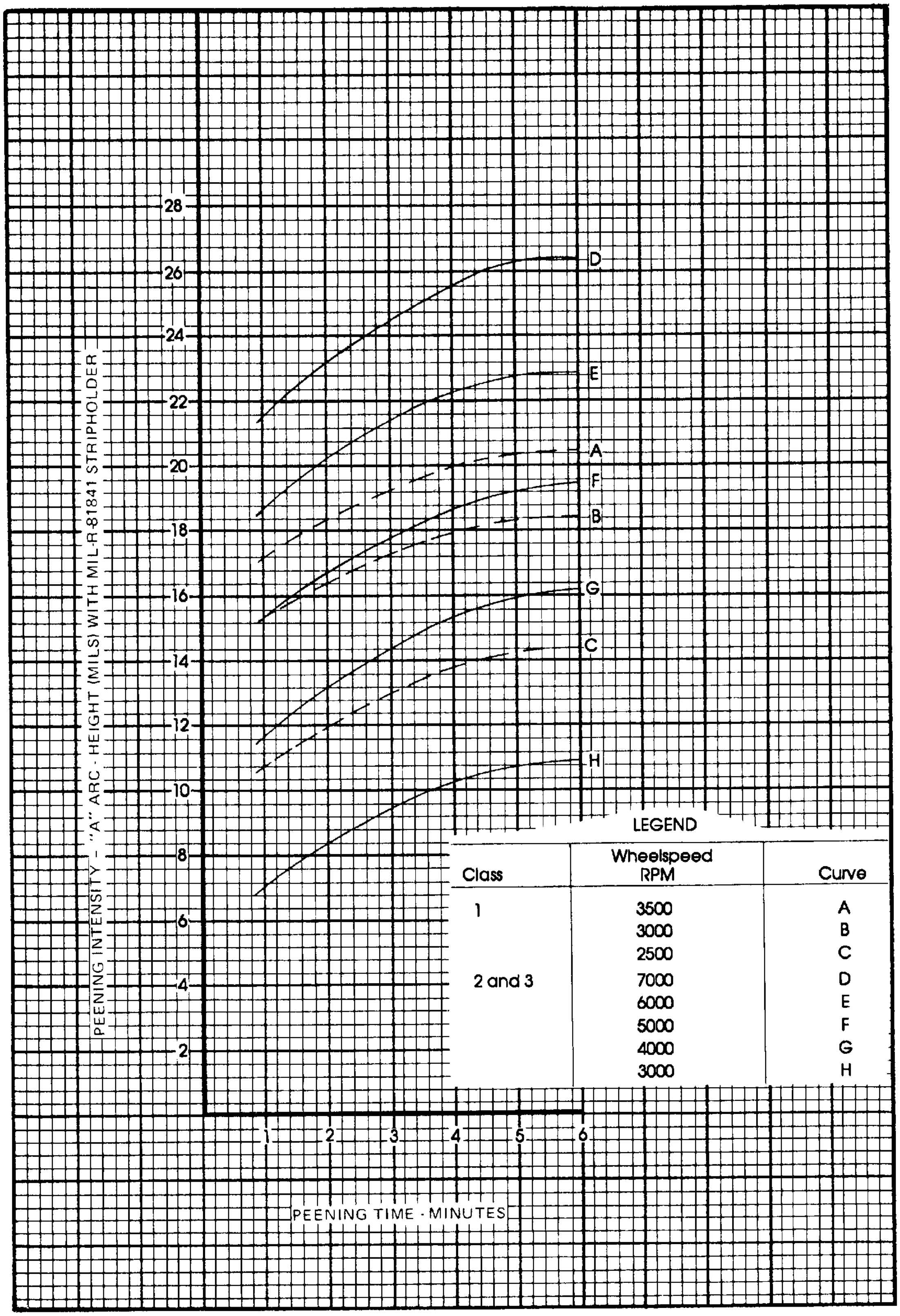


Figure E–3. Saturation Coverage Curves for Type II Wheels of MIL–W–81840

SECTION III

CHEMICAL CORROSION REMOVAL ALUMINUM ALLOYS

E–12. INTRODUCTION. This section outlines procedures for the chemical removal of corrosion from aluminum alloy parts and assemblies of aircraft missiles, or other equipment or systems. Table E–6 provides procedures for the removal of specific types of corrosion.

E–13. PREPARATION. Before starting chemical removal of corrosion products, ensure that the following steps are taken:

a. Clean surfaces in accordance with Chapter 3 to remove all dirt, grease, and contamination.

b. Inspect the equipment and determine area(s) that should be treated with chemical corrosion removal compound. If an aircraft is being prepared for complete painting or repainting, all cleaned bare aluminum surfaces should be treated.

CAUTION

Protect magnesium surfaces from prepaint corrosion removal compound (MIL–C–38334) and treat later, as prescribed in this manual. Steel and cadmium plated parts should also be protected from this compound.

Do not use chemical corrosion removers on high strength steel. Hydrogen embrittlement may occur leading to catastrophic failure.

c. Mask all lap joints, hinges, faying surfaces, access doors, air scoops, and other openings that would allow the corrosion remover to enter interior areas or crevices. Also, mask otherwise unprotected magnesium, steel, and cadmium plated parts. Masking can be accomplished using waterproof barrier paper (MIL–B–131) and masking tape (MIL–T–23397, Type II). 3M Corporation No. 425 tape is the most effective tape for extensive operations, such as depot repaint surface preparation.

E–14. CHEMICAL CORROSION REMOVERS (ALUMINUM).

WARNING

MIL–C–38334 and Pasa–Jell 102 are moderately toxic to skin, eyes, and respiratory tract. Chemical or splash proof goggles and rubber gloves are required; good general ventilation is normally adequate.

E–14.1. Corrosion removal compound, prepaint (MIL–C–38334) and Pasa–Jell 102 (SEMCO), aluminum type, are recommended for use in removing corrosion products from aluminum alloys. Limited area corrosion removal can also be accomplished by using MIL–C–81706 solution and abrasive mats.

E–14.2. Corrosion removal compound, prepaint (MIL–C–38334). MIL–C–38334 is used to remove corrosion products from aluminum and is not required to be LOX compatible. MIL–C–38334 is available in two types:

a. Type I. Type I liquid concentrate materials shall be diluted with an equal volume of water before use; further dilution renders them ineffective. These materials have a shelf life of one year from the date of manufacture; discard materials when the shelf life is reached.

b. Type II. Type II powdered concentrate kit materials shall be dissolved in the volume of water specified on the kit. These materials have an indefinite shelf life in the dry state. The solution made from powdered concentrates should be used within 90 days after mixing; discard materials after 90 days.

Table E–6. Typical Corrosion Removal Precedures for Aluminum Alloys and Assemblies

Type of Corrosion	Step 1 Corrosion Removal	Step 2 Surface Treatment (When applicable)	Step 3 Final Protective Paint Finish (When applicable)
Light or heavy pitting or etching of aluminum	Remove corrosion with-MIL–C–38334 (refer to E–14.1)	MIL–C–81706 (refer to Chapter 5)	See E–13 for paint systems
Light or heavy pitting or etching of aluminum (non–clad)	Remove corrosion by mechanical method (refer to Chapter 5) or MIL–C–38334 (refer to E–14.1)	As above	As above
Intergranular or exfoliation corrosion of aluminum	Remove corrosion by mechanical method (refer to Chapter 5)	As above	As above
Light or heavy corrosion on small aluminum parts which can be removed for treatment	Remove corrosion and oxide film by immersion in a solution of one part MIL–C–38334 and one part water (refer to E–14.1)	Immersion in MIL–C–81706 (refer to Chapter 5)	As above
Stress corrosion cracking of aluminum	Not applicable; replace/repair as required in the structural handbook	See step 1	See step 1

E–14.2.1. Application of MIL–C–38334. Use the following procedure:

a. Apply MIL–C–38334 solution by flowing, mopping, sponging, brushing, or wiping. When applying the solution to large areas, begin the application at the lowest area and work upward, applying the solution with a circular motion to disturb the surface film and ensure proper coverage. If pumping is required, pumps, valves, and fittings shall be manufactured from 18–8 stainless steel or plastic.

b. Allow the solution to remain on the surface for approximately 12 minutes and then rinse away with potable water. The solution will be more effective if applied warm {140_F (60_C) maximum} followed by vigorous agitation with a nonmetallic, acid resistant brush or aluminum oxide abrasive nylon mat (A–A–58054, Type I, Grade A). In the case of severe pitting, the removal may be aided by lightly hand agitating the pits with a corrosion resistant steel wire brush (0.005 to 0.006 inch maximum diameter of filament wire) (H–B–178/3–2). Heavily corroded or pitted areas may require more than one application of MIL–C–38334.

c. After each application and rinse, examine the area being treated with a 10X magnifying glass to determine if another application is required.

NOTE

TM 1–1500–344–23 Chromate conversion coating (MIL–C–81706) shall be applied immediately after the final rinse when corrosion removal is the last process of a rework operation, or when the item or area will be painted.

E–14.3. Pasa–Jell 102 (SEMCO) – aluminum type. Pasa–Jell 102 (SEMCO) – aluminum type is used in areas where LOX compatibility is required. Pasa–Jell is a relatively strong acid mixture and can be detrimental to equipment or components if improperly used; therefore, it shall only be used where LOX compatibility is an essential requirement and by personnel who are properly trained and qualified to use the material for corrosion removal.

WARNING

Do not use aluminum or steel wool to apply or agitate Pasa–Jell; fire will result.

The excessive use of abrasive and Pasa–Jell causes unnecessary removal of protective clad or metal.

E–14.3.1. Application of Pasa–Jell 102. Use the following procedure:

a. Apply with an acid resistant brush. Agitate areas of deep pitting with an acid resistant brush with short fibers or an abrasive mat (A–A–58054, Type I) until corrosion products are removed. A thin smooth, and evenly dispersed film will give the best results. The dwell time should be kept to the minimum necessary to effectively remove the corrosion (five to 12 minutes). It can usually be controlled by closely observing the reaction of the Pasa–Jell 102 mixture with the aluminum surface to which it is applied.

b. After the Pasa–Jell 102 has been allowed to dwell, rinse it away with a stream of water or wipe off with a clean, moist cloth, frequently rinsing the cloth in clean water.

c. One application of Pasa–Jell 102 should be sufficient in most cases; however, in severe cases, the preceding steps may have to be repeated. Attention should be given to pitted areas until all corrosion is removed. Questionable areas should be examined with a 4X or stronger magnifying glass. Corrosion still located on the area will appear as a powdery crust, slightly different in color than the uncorroded base metal.

E–14.4. Corrosion removal and chromate conversion coating with MIL–C–81706 materials.

WARNING

MIL–C–81706 chromate conversion coatings are hazardous and all appropriate safety measures must be followed. They are moderately toxic to the skin, eyes, and respiratory tract. Chemical or splash proof goggles and rubber gloves are required; good general ventilation is normally adequate.

CAUTION

MIL–C–81706 materials (mixed solution) shall not be used on high strength steels (180 KSI or higher), due to the potential of hydrogen embrittlement, nor shall this solution be used on magnesium, titanium, or cadmium or zinc plated parts.

E–14.4.1. Limited area corrosion removal on aluminum alloys with simultaneous chromate conversion treatment can be accomplished using MIL–C–81706, Class 1A. It is recommended that the technician practice on some condemned aircraft components or parts prior to using this material on serviceable aircraft aluminum alloys or parts. This material will help clean metal surfaces, remove corrosion, and produce a chromate conversion film on aluminum surfaces. It will act as a cleaning agent by oxidizing all organic soils on the aluminum surface. If organic soils are present they will turn green upon application of the solution. The green residue and/or treat solution contaminated with the residue should be wiped from the surface and discarded. Mix the solution in accordance with the manufacturer's instructions. MIL–C–81706 is also available in several forms (see Appendix A).

E–14.4.2. Application of MIL–C–81706. The procedures are the same as those previously cited for the standard conversion material, except:

a. The area where corrosion removal and treatment are required should be cleaned, rinsed, and permitted to dry. For small areas, the cleaning may be done with the chromate conversion solution.

b. Thoroughly wet or flood the area with the solution. The surface should be kept completely wetted with the solution at all times until each phase of work is completed and/or the final film is formed, to prevent streaking and powdering.

c. Lightly abrade the area, while wet with solution, with a fine nylon abrasive mat (A–A–58054) wetted with the solution.

d. If the solution turns green continue scrubbing until the entire area has been cleaned, then remove all the dirty solution with a sponge. This should leave the area bright and shiny. except for moderately to severely corroded areas, which show up as dark spots or lines. The solution should be reapplied to these areas and vigorously agitated with the fine nylon abrasive pad (A–A–58054). If all corrosion is not removed by reapplication of the solution and heavy scrubbing with the fine nylon abrasive pad, the area should be wiped completely dry. Corrosion on these areas should be removed by mechanical or chemical means, as cited in this manual or the applicable weapon system corrosion control technical manual. After corrosion has been removed and the surface has been polished or cleaned, reapply the conversion coating solution and allow the film to form. For formation on the film or coating use the techniques and procedures previously cited for the brush method of application.

E–15. PAINT SYSTEMS. Refer to T.O. 1–1–4 and –23 T.O.'s for aircraft, T.O. 35–1–3 for support equipment, or specific repair T.O.'s in order to determine the proper paint system to be used. See T.O. 1–1–8 for application procedures. Apply MIL–C–81706 in accordance with the basic text prior to painting.

SECTION IV

CHEMICAL CORROSION REMOVAL
MAGNESIUM ALLOYS

E-16. INTRODUCTION. This section outlines procedures for the chemical removal of corrosion from magnesium alloy parts and assemblies of aircraft, missiles, or other equipment or systems. Table E-7 provides procedures for the removal of specific types of corrosion. Removable parts can be treated more effectively by electro-mechanical conversion coating, using methods outlined in Specification AMS-M-3171.

E-17. PREPARATION. If the corroded area is soiled by grease, dirt or other foreign materials, it will be necessary to clean the area prior to any paint stripping or corrosion removal. See Chapter 3 for procedures pertaining to the cleaning of painted or unpainted surfaces where immersion, spray, or vapor cleaning is not practical. Complete procedures for cleaning magnesium alloys by immersion, spray, and vapor methods are included in Specification AMS-M-3171.

E-18. CHEMICAL CORROSION REMOVER (MAGNESIUM).

WARNING

> Do not allow rags, brushes, etc., which have been soaked with chromic acid to come in contact with any type of organic solvent, such as MEK, acetone, paint thinner, or dry cleaning solvent (P-D-680, Type II): fire may result.

E-18.1. The following chromic acid pickle solution may be used to remove surface oxidation and light corrosion products from magnesium surfaces. It is not considered adequate where deep pitting or heavy corrosion which require mechanical methods has occurred, nor is it satisfactory for removing sand or the effects of blasting. The chemical method causes less reduction in section thickness, if properly used. This method shall not be used for parts containing copper and steel based inserts unless the inserts are masked off. Excessive amounts of anions, such as chlorides, sulfates, and fluorides, must not be allowed to build up in the solution, as they tend to coat or etch the metal rather than clean the surface.

E-18.2. Application of chromic acid pickle. Use the following procedure:

a. The solution consists of 24 ounces of chromium trioxide (O-C-303, Type II) and enough water to make one gallon of solution. The normal reaction time range is from one to 15 minutes, and the normal operating temperature range is from 190_ to 202_F (88_ to 94_C); the solution can be operated at room temperature for a longer reaction time, if desired. The solution container shall be con-structed from lead lined steel, stainless steel, or 1100 aluminum.

b. Mask off nearby operating mechanisms, cracks, and plated steel to keep the solution from attacking them.

c. Apply the chromic acid solution carefully to the corroded area with an acid resistant brush.

d. Allow the solution to remain on the surface for approximately 15 minutes; agitation may be required.

e. Thoroughly rinse the solution from the surface with plenty of clean water.

f. Repeat the preceding sequence as necessary until all corrosion products have been removed and the metal is a bright metallic color.

g. Apply the chemical pretreatment and finish recommended for the area.

E-19. PAINT SYSTEMS. Refer to T.O. 1-1-4 and specific weapons system corrosion manuals for aircraft, T.O. 35-1-3 for support equipment, or specific repair T.O.'s in order to determine the proper paint system to be used. See T.O. 1-1-8 for application procedures. Apply AMS-M-3171, Type VI in accordance with the basic text prior to painting.

Table E–7. Typical Corrosion Removal Procedures for Magnesium Alloys

Type of Corrosion	Step 1 Corrosion Removal	Step 2 Surface Treatment	Step 3 Protective Finish
Light pitting or surface oxidation	Remove corrosion with chromic acid pickle solution (refer to E–18)	AMS–M–3171 Type VI (refer to Chapter 5)	Approved paint system (refer to E–19)
Heavy pitting or etching	Remove corrosion by mechanical (refer to Chapter 5) and chemical methods (refer to E–18)	As above	As above
Intergranular or exfoliation	Remove corrosion by mechanical method (refer to Chapter 5)	As above	As above
Light or heavy corrosion on small parts which can be removed for treatment	In accordance with Specification AMS–M–3171	As above	As above
Stress corrosion cracking	Not applicable; replace/repair as required in the structural handbook	Not applicable	Not applicable

NOTE

The final protective paint system or primer shall be applied on a completely dry surface within 48 hours after application of the AMS–M–3171 or chromic acid brush–on pretreatment. A second pretreatment coating shall be applied over the previous coatings if more than 48 hours have elapsed since the previous application.

SECTION V

CHEMICAL CORROSION REMOVAL, FERROUS METALS OTHER THAN STAINLESS STEEL

E–20. INTRODUCTION. This section outlines procedures for treating ferrous alloy parts and assemblies of aircraft or missile systems and ground support. Table E–8 provides procedures for the removal of specific types of corrosion.

E–21. PREPARATION. If the corroded area is soiled by grease, dirt, or other foreign materials, it is necessary to clean the area prior to any paint stripping or corrosion removal.

E–22. CHEMICAL CORROSION REMOVERS (FERROUS ALLOYS OTHER THAN STAINLESS STEEL). Chemical corrosion removal is recommended for use when there is no danger of the chemicals becoming trapped in crevices or recesses. Chemical rust removers are of the acid type (MIL–C–10578) and alkaline type (MIL–C–14460).

<u>E–22.1. Corrosion removing and metal conditioning compound (MIL–C–10578).</u> Phosphoric acid–type corrosion remover compounds, MIL–C–10578 materials, are used to remove corrosion from ferrous metal surfaces. The following types are available.

a. Types I and II. Types I and II materials are suitable as rust removers for ferrous metal parts and as metal conditioners for ferrous and nonferrous metals prior to the application of paints and/or corrosion preventives. Very heavy rust incrustation should be mechanically removed and heavy grease should be removed by adequate grease solvents or grease removal methods. Type I material will remove more rust and grease than Type II material. Type I material should always be rinsed off with water after application. Type II material does not have to be rinsed off with water but may be wiped off with clean rags prior to painting.

b. Type III. Type III conditioner is intended for use on chromium plated ferrous surfaces and on those ferrous surfaces which require very close tolerances. First, mechanically remove very heavy rust incrustation, and remove grease by vapor degreasing. The article is then left in the conditioner until the rust is dissolved or loosened sufficiently to permit easy removal. After rust removal, rinse and dry the article. It is then ready for further corrosion preventive treatment or for use.

c. Type IV. Type IV material is similar to Type I material, except that nonfossing detergents are used. It is intended for use in pressurized spray systems up to 150_F (66_C), after which it is washed off with water.

d. Type V. Type V material is similar to Type I material, except that grease removing solvents are not used and that the material is suitable for use on surfaces from which grease and oil have been previously removed by solvent or alkali cleaning. It may be used in immersion tanks at ambient temperatures or at temperatures not exceeding 140_F (60_C).

<u>E–22.1.1. Application of MIL–C–10578.</u>

<u>WARNING</u>

Phosphoric acid corrosion removal compounds are toxic to the skin, eyes, and respiratory tract. Chemical or splash proof goggles and rubber gloves are required. Use only in a well ventilated area. In case of eye or skin contact, flush immediately with water and report to the Base Medical Service.

When mixing, always add the phosphoric acid corrosion remover to the water. Do not add the water to the acid, since excessive heat will be generated.

Do not use acidic materials if there is a danger of entrapping the material in crevices, recesses, or on high strength steels.

Table E–8. Typical Corrosion Removal Procedures for Ferrous Metals Other Than Stainless Steel

Type of Corrosion	Corrosion Removal
Light or heavy rust on parts as above where chemical rust removal	Remove corrosion by wire brushing and/or sanding followed by phosphoric acid etch with MIL–C–10578 material (refer to E–22.1)
Light or heavy rust on small parts where vat treatment is practical	a. Acid method: Remove corrosion by immersing parts in phosphoric acid solution (refer to E–22.1). b. Alkaline method (recommended for critical or mechanical surfaces): Remove corrosion by immersing parts in alkaline solution, MIL–C–14460, Type I (refer to E–22.2)

CAUTION

Steel parts heat–treated above Rockwell C40 (180,000 psi) tensile strength are subject to hydrogen embrittlement; therefore, the use of acids on these parts is prohibited.

Do not use acidic materials if there is a danger of entrapping the material in crevices, recesses, or on high strength steels.

E–22.1.1.1. Type I (wash–off). The directions for use are:

a. Add one part of the concentrated material as received to three parts of water by volume. Use stainless steel, aluminum, vinyl, polyethylene, or rubber mixing containers.

b. Remove heavy rust and heavy grease before applying the compound. Protect adjacent components to prevent damage by scale, chips, corrosion products, or chemicals.

c. After proper dilution, apply by spray (non–atomized), dip, or flow–brush on clean metal surfaces. Allow the material to remain only long enough to wet the surface and cause etching. On rusted surfaces, allow the material to remain long enough to loosen the rust (from two to 10 minutes, depending on the degree of rusting).

d. The solution may be agitated with an abrasive mat or a stainless steel wire brush.

e. Rinse the surface with water, preferably hot. Allow the surface to dry thoroughly prior to application of rust preventive or paint.

E–22.1.1.2. Type II (wipe–off). The directions for use are:

a. Add one part of the concentrated material as received to three parts of water by volume. Use mixing containers as specified in E–22.1.1.1.

b. Remove heavy rust and heavy grease before applying the compound. Protect adjacent components to prevent damage by scale, chips, corrosion products, or chemicals.

c. After proper dilution, apply by brush, rag, or sponge. Allow the compound to remain on the metal surface for about 30 seconds.

d. Wipe off residue first with damp rags, then with dry rags. No more than a light film of gray–white coating shall remain before the application of paint.

E–22.1.1.3. Type III (non–atomized spray and flow–brush). The directions for use are:

a. Add one part of the concentrated material as received to one part of water by volume. Use mixing containers as specified in E–22.1.1.1.

b. Remove heavy rust and grease before applying the compound. Protect adjacent components to prevent damage by scale, chips, corrosion products, or chemicals.

c. After proper dilution, apply by nonatomized spray or flow–brush. Allow the conditioner to remain on the surfaces long enough so that the rust is loosened or dissolved and may be removed with hot water.

d. When the surface is dry, it may be coated, preserved with a corrosion preventive, or put directly into service, as circumstances indicate.

E–22.1.1.4. Type III (Dip or immersion).

WARNING

Heated dip tanks shall be properly ventilated, and ventilation shall be evaluated by the Bioenvironmental Engineer.

E–22.1.1.4.1. Corrosion resistant steel tanks are preferred for use with this method. The directions for use are:

a. Mix as specified for brush and spray.

b. Immerse the part in the solution only long enough to loosen the rust. For removal of heavy rust the solution can be heated to 140_F (60_C) maximum.

c. Agitate the part in the solution to further increase the rate of rust removal. Rinse in a continuously overflowing cold water rinse tank, if available, or spray with clean (preferably hot) water. Dry the parts and immediately apply the final protective paint or other corrosion preventive finish.

E–22.1.1.5. Type IV (non–foaming). The directions for use are:

a. Add one part of the concentrated material as received to three parts of water by volume. Use mixing containers as specified in E–22.1.1.1.

b. Remove heavy rust and heavy grease before applying the compound.

c. After proper dilution, apply the solution by non–atomized spray.

d. Rinse with water, preferably hot.

e. Allow thorough drying prior to application of rust preventive or paint.

E–22.1.1.6. Type V (immersion tank). The directions for use are:

a. Add one part of the concentrated material as received to three parts of water by volume. Use mixing containers as specified in E–22.1.1.1.

b. Remove heavy rust and all grease before immersion in the compound.

c. After immersion, wash metal surfaces thoroughly with water or alkali solution followed by water.

d. Allow thorough drying prior to application of rust preventive or paint.

E–22.2. Corrosion removing compound. sodium hydroxide base (MIL–C–11460, Type I). This remover is suitable for rust removal by simple immersion of the parts without causing dimensional change of critical or machined surfaces. It can be used on small parts with or without paint, grease, or other surface coatings.

E–22.2.1. Application of MIL–C–14460, Type I.

CAUTION

Rust remover (MIL–C–14460, Type 1) is highly alkaline and, therefore, toxic to the skin, eyes, and respiratory tract. Chemical or splash proof goggles and rubber gloves are required. Heated dip tanks shall be properly ventilated, and ventilation shall be evaluated by the Bioenvironmental Engineer.

The directions for use are:

a. Prepare the alkaline rust remover in accordance with the manufacturer’s instructions as printed on the container. The usual concentration used for Type I materials is five pounds per gallon of water. Carbon steel or corrosion resistant tanks may be used.

b. Immerse the parts in the rust remover solution. Rust removal time varies with the extent of the rust. Temperatures up to the boiling point of the solution may be used to increase the rate of rust removal.

c. Rinse thoroughly in clean (preferably hot) water.

d. Dry thoroughly and immediately apply final protective finish or other corrosion preventive compound.

E–23. PAINT SYSTEMS. Refer to T.O. 1–1–4 and –23 T.O.'s for aircraft, T.O. 35–1–3 for support equipment, or specific repair T.O.'s in order to determine the proper paint system to be used. See T.O. 1–1–8 for application procedures.

SECTION VI

CHEMICAL CORROSION REMOVAL, STAINLESS STEEL AND NICKEL-BASE ALLOYS

E-24. INTRODUCTION. This section outlines procedures for the chemical removal of corrosion from stainless steel parts and assemblies. Table E-9 provides procedures for removing specific types of corrosion.

E-25. PREPARATION. If the corroded area is soiled by grease, dirt, or other foreign materials, consult Chapter 3 of this manual. Chemical removal of corrosion is recommended for severely corroded areas where there is no danger of the chemicals becoming entrapped in recesses or structural complexities or the possibility of damaging surrounding metals and plating. Use the following chemical procedures on installed components not readily removable. Protect adjacent unaffected areas not being treated to prevent additional corrosive attack. When internal corrosion is evident the components shall be removed and processed through an overhaul facility in accordance with the specific directives.

WARNING

Solvent (P-D-680, Type II or III) is toxic to the skin, eyes, and respiratory tract. Skin and eye protection are required. Avoid repeated or prolonged contact or inhalation. Good general ventilation is normally adequate.

When using metallic wools, wear leather gloves and exercise care to avoid injury.

CAUTION

Do not allow solvents to splash or run because they also remove paint and damage elastomers (e.g., rubbers, plastics).

Take care to protect surrounding unaffected areas next to the area being treated by avoiding leakage of chemicals into recesses or inaccessible areas in order to prevent additional damage from corrosion attack.

a. Remove all loose corrosion by rubbing with stainless steel wool or silicone carbide paper (A-A-1047). Remove loose particles by wiping with a clean cloth dampened with solvent (P-D-680, Type II or III).

E-26. APPLICATION OF PASA-JELL NO. 101.

WARNING

Do not use aluminum or steel wool to agitate Pasa-Jell, as a combustible reaction will occur. Pasa-Jell contains strong acids. Observe standard safety precautions for handling acids and wear protective clothing. Avoid inhaling fumes and provide adequate ventilation.

In areas of oxygen storage and transfer systems, remove remaining corrosion by applying liquid oxygen compatible corrosion remover (Pasa-Jell No. 101, stainless steel type) with an acid resistant brush (H-B-643).

a. For removal of light to medium corrosion, apply Pasa-Jell to affected areas, agitating with an acid resistant brush if necessary. For heavy corrosion where pitting is present, agitate Pasa-Jell on surface with an abrasive mat (A-A-58054, Type 2) until all corrosion embedded in pits and on the surface is removed.

b. Remove Pasa-Jell solution and corrosion products with clean, lint-free cloth frequently rinsed in clean water. For final wipe use clean, lint-free dry cloth.

E-27. APPLICATION OF MIL-C-10578, TYPE III. Use the following procedure:

a. In areas where there is no danger of liquid oxygen spillage, corrosion may be removed with phosphoric acid base rust remover (MIL-C-10578, Type III).

Table E-9. Typical Corrosion Removal Procedures for Stainless Steel

Type of Corrosion	Step 1 Corrosion Removal	Step 2 Surface Treatment	Step 3 Protective Finish
Light or heavy rust or pitting on installed parts where chemical rust removal is impractical because of the complexity of the structure or rinsing difficulties	Remove corrosion with stainless steel wool or wire brush, rotary file, carborundum paper, or other mechanical means (refer to Chapter 5)	None	Normally not required; see E-29 for discussion of paint systems which may be used if required
As above, when chemical rust removal is practical	Remove heavy corrosion by brushing, sanding, etc., followed by chemical corrosion removal with Pasa-Jell chemical corrosion remover (see E-26)	None	See E-29 for the approved paint system
Light or heavy corrosion on parts which can be removed for processing	Mechanical: Remove corrosion by wire brushing, sanding, grinding, or other mechanical means (see Chapter 5) Chemical: Remove corrosion by pickling in nitric-hydrofluoric acid solution (see E-28)	Passivate in nitric acid solution followed by treatment in sodium dichromate solution (see E-28)	As above

b. Thoroughly rinse all chemical corrosion remover from the area.

c. Allow the area to dry, then apply final protective finish or other corrosion preventive if required.

E-28. PICKLING FOR CORROSION REMOVAL (FOR USE AT DEPOTS AND OTHER AUTHORIZED FACILITIES).

WARNING

Scale loosening, pickling, and passivating solutions are strong acids and, therefore, toxic to the skin, eyes, and respiratory tract. Chemical or splash proof goggles and rubber gloves are required. In case of eye or skin contact, flush immediately with water and report to the Base Medical service. Dip tanks shall be properly ventilated, and ventilation shall be evaluated by the Bioenvironmental Engineer.

CAUTION

The heat-treatable stainless steel alloys, such as AISI Types 403, 410, 420, and others, are susceptible to cracking when placed in pickling solutions. Use only mechanical methods to remove corrosion from these alloys.

E-28.1. Pickling solutions. Mixtures of nitric acid (O-N-350) and hydrofluoric acid (MIL-A-24641) in water are recommended. The correct percentage content of the two acids for a given corrosion removal job shall be determined by testing. The nitric acid volume content may vary from 5 to 50%; the hydrofluoric acid volume content may vary from 0.5 to 5%. Normally, a solution containing 12 to 15% of nitric acid and 1% of hydrofluoric acid in water is used to remove light scale or corrosion. The percentage of hydrofluoric acid may be increased to remove heavier scale or corrosion. The more nitric acid present with respect to hydrofluoric acid, the less rapid the corrosion or scale removal. Nitric acid acts to inhibit the action of hydrofluoric acid. Rubber lined or Koroseal tanks may be used to hold solutions.

E–28.3. Pickling temperature. The pickling temperature may be adjusted from ambient temperature to 140_F (60_C). Higher temperatures shall be avoided to reduce evaporation loss of hydrofluoric acid. Temperatures below 120_F (49_C) should be used if intergranular attack is experienced in localized areas, such as weld zones. AISI 300 Series stainless steels may be used to manufacture steam coils to heat the solution. The heating coils should be installed so that they are easily replaced, since they will be corroded by the solution.

E–28.3. Testing to determine pickling conditions. Optimum pickling conditions (temperature, time, and acid concentration) shall be determined by exposure of test panels to all conditions of the cleaning cycle. Excessive etching or intergranular attack of the base metal shall be avoided.

a. Make test panels, one by four inches square, of the same material as that of the material being cleaned. Process the test panels through the complete cleaning and pickling cycle.

b. If etching or intergranular attack is excessive (i.e., would cause the component to be condemned), or if cleaning is not complete, adjust the acid concentration, immersion time, or solution temperature until the desired result is obtained. Table E–10 shows the effect of the variables (acid concentration, immersion time, and solution temperature) on the pickling action of the solution.

E–28.4. Typical pickling procedures.

WARNING

The scale loosening solution, the pickling solution, and the passivating solution all contain strong acids. Observe standard safety precautions for handling acids. Wear protective clothing, avoid inhaling fumes, and provide adequate ventilation. Tanks must be provided with a lateral exhaust ventilation system.

E–28.4.1. The following procedures are merely guidelines for acid pickling. Competent operators must test to establish specific procedures, as outlined in E–28.3. A scale loosening procedure is included for use only if severe scale is encountered and it is desired to loosen the scale by chemical means. Normally heavy scale may be removed by mechanical means prior to acid pickling. A passivating procedure is also included and may be used following pickling. Solvent or vapor degreasing, in accordance with T.O. 42C–1–20, shall precede the following procedures.

a. If necessary, remove severe scale by a mechanical method (see Chapter 5).

b. If necessary, loosen severe scale by immersing parts in an 8 to 10% by weight solution of sulfuric acid (O–S–809) in water at 150_ to 160_F (66_ to 71_C) for approximately five minutes. Observe results and repeat if required. Scrub as required to remove sludge.

c. Rinse parts quickly and thoroughly in clean, hot water.

d. Transfer parts to the nitric–hydrofluoric acid pickling bath. A typical bath consists of 15% nitric acid (O–N–350), 2 to 3% hydrofluoric acid (MIL–A–24641), and 82 to 83% water, all by volume.

e. Immerse parts for five to 15 minutes at a temperature range of 60_ to 140_F (16_ to 60_C). Scrub or agitate as required.

NOTE

The required acid concentration, temperature, and time shall be determined by test (see E–28.3) prior to the start of the pickling operation.

Table E–10. Control of Dissolving Action of Nitric–Hydrofluoric Acid Solutions

Dissolving Or Pickling Action Is More Severe	Dissolving Or Pickling Action Is Less Severe
1. When the nitric acid content is increased and/or the hydrofluoric acid content is decreased	1. When the nitric acid content is decreased and/or the hydrofluoric acid content is increased
2. When the temperature is increased	2. When the temperature is decreased
3. When immersion time is increased	3. When immersion time is decreased

NOTE

Ensure that the parts are completely immersed in these solutions to prevent corrosion attack at the liquid level line of part.

New welds should be mechanically vibrated during the pickling operation.

f. Rinse parts thoroughly in clean, hot water immediately after removal from the pickling solutions.

g. Transfer the parts to a passivating solution for treatment as follows:

(1) Immerse parts in an aqueous solution containing 20 to 50% of nitric acid (O–N–350) by volume and 2 to 3% of sodium dichromate (O–S–595) by weight. For austenitic and ferritic alloys, immersion shall be for 30 to 60 minutes at room temperature. For martensitic alloys, immersion shall be for 20 to 40 minutes at 120_ to 130_F (49_ to 54_C).

(2) Rinse in clean, hot water.

(3) Immerse ferritic or martensitic stainless steel parts for 30 minutes in a hot aqueous solution {140_ to 160_F (60_ to 71_C)} containing 4 to 6% sodium dichromate.

(4) Rinse thoroughly and dry.

E–29. TYPICAL PAINT SYSTEMS. Stainless steels are normally not painted. However, where extreme corrosive conditions are encountered, where organic finishes are required for decorative purposes, or where the steel is in contact with a dissimilar anodic metal, painting may be required. Refer to T.O. 1–1–4 and –23 T.O.'s for aircraft, T.O. 35–1–3 for support equipment, or specific repair T.O.'s in order to determine the proper paint system to be used. See T.O. 1–1–8 for application procedures.

SECTION VII

CORROSION REMOVAL, COPPER AND COPPER–BASE ALLOYS

E–30. INTRODUCTION. This section outlines procedures for the chemical removal of copper and copper alloy parts and assemblies of aircraft or missile systems. Table E–11 provides procedures for removing specific types of corrosion.

E–31. PREPARATION. If the corroded area is soiled by grease, dirt, or other foreign materials, consult Chapter 3. Corrosion can be removed from copper with phosphoric acid base rust remover provided that there is no danger of entrapping the acid in crevices or recesses. Protect adjacent components to prevent damage by chemical agents. Remove oil, grease, or soil from the area to be treated with cleaner and/or solvent.

E–32. APPLICATION OF MIL–C–10578, TYPE III. Use the following procedure:

a. Apply phosphoric acid base rust remover (MIL–C–10578, Type III) with an acid resistant brush, and agitate lightly.

b. Rinse the area, thoroughly dry, and apply final protective paint or other finish if required (see E–34).

E–33. IMMERSION IN SULFURIC ACID SOLUTION.

WARNING

Sulfuric acid solutions are toxic to the skin, eyes, and respiratory tract. Chemical or splash proof goggles and rubber gloves are required. In case of eye or skin contact, flush immediately with water and report to the Base Medical Service.

Compressed air used for drying purposes can cause airborne particles that may enter the eyes. Eye protection is required. Air pressure shall not exceed 30 psi.

E–33.1. Components which can be disassembled can be treated in immersion tanks. The tanks should be manufactured from or lined with stainless steel, lead, ceramic, glass, or acid resistant rubber. Immersion racks should be manufactured from stainless steel or Monel. The proper conditions (i.e., time, temperature, and acid concentration) for the process should be determined by test, using panels of the same material which is to be tested. Tanks must be provided with a lateral exhaust ventilation system. A typical procedure follows:

a. Disassemble the component as necessary.

NOTE

Do not process dissimilar metals in acid baths.

b. Degrease parts by immersion, spray, or vapor cleaning (see T.O. 42C–1–20).

c. Immerse parts in a 5 to 10% by volume aqueous solution of sulfuric acid (O–S–809). Maintain solution between 60_ and 120_F (16_ and 49_C). The required temperature, immersion time, and acid concentration shall be determined by test (see E–28.3).

d. Rinse thoroughly.

Table E–11. Typical Corrosion Removal Procecdures for Copper and Copper Alloys

Type of Corrosion	Step 1 Corrosion Removal	Step 2 Surface Treatment	Step 3 Protective Finish
Tarnish or colored corrosion products on installed compo– nents whenever chemical corrosion removal is practical	Remove corrosion with phosphoric acid base rust remover (MIL–C–10578, Type III) (see E–32)	Not required	See E–34 for specific instructions
Corrosion on parts which can be disassembled for immersion treatment	Remove corrosion by immersion in sulfuric acid solution (see E–33)	If required, remove stain by immersion in sulfuric acid–sodium dichromate solution (see E–33)	As above

e. If a red stain appears on the parts following the above treatment, remove the stain by immersing parts in a solution containing the following:

(1) Sulfuric acid (O–S–809). 4 to 10%, by volume;

(2) Sodium dichromate (O–S–595). 4 to 8 ounces per gallon of solution; and

(3) Water, remainder.

f. Maintain the above solution at 60_ to 120_F (16_ to 49_C). The required temperature, immersion time, and acid concentration shall be determined by test.

g. Rinse thoroughly.

NOTE

Thorough rinsing is important, since any residual acid will cause staining of the metal surface.

h. Dry rapidly, preferably with hot air. Rapid drying will prevent water stains on the surface.

E–34. TYPICAL PAINT SYSTEMS. Normally copper and copper alloys are not painted. However, if paint is required, refer to T.O. 1–1–4 and –23 T.O.'s for aircraft, T.O. 35–1–3 for support equipment, or specific repair T.O's in order to determine the proper paint system to be used. See T.O. 1–1–8 for application procedures.

SECTION VIII

CORROSION REMOVAL, TITANIUM AND TITANIUM–BASE ALLOYS

E–35. INTRODUCTION. This section outlines procedures for the chemical removal of corrosion from titanium parts and assemblies. Table E–12 provides procedures for removing specific types of corrosion.

E–36. PREPARATION. If the corroded area is soiled by grease, dirt, or other foreign materials, consult Chapter 3. Remove gray or black oxide by mechanical means, if present. Remove soil by vapor degreasing or other cleaning methods (see Chapter 3).

E–37. IMMERSION IN NITRIC–HYDROFLUORIC ACID SOLUTION.

WARNING

Nitric–hydrofluoric acid solutions are toxic to the skin, eyes, and respiratory tract. Chemical or splash proof goggles and rubber gloves are required. In case of eye or skin contact, flush immediately with water and report to the Base Medical Service. Use only in well–ventilated areas.

E–37.1. An acid pickle will remove most oxide coatings from titanium, provided the scale was formed at temperatures below 1000_F (540_C). Gray or black oxides should be removed by a mechanical method, such as abrasive blasting, prior to the acid pickle to prevent pitting of the titanium. Titanium is susceptible to hydrogen embrittlement in acid solutions; therefore, the acid pickle should be used only when other corrosion methods are not adequate. Competent operators must be assigned to monitor the process.

a. Immerse parts in an aqueous solution normally containing 20% nitric acid (O–N–350) and 3% hydrofluoric acid (MIL–A–24641), both by volume. Maintain the solution at normal room temperature. Allow the parts to remain in the solution only long enough to remove the oxide coats. Intermittent wiping with a brush or cloth during the pickling operation will facilitate oxide removal with a minimum of pitting.

NOTE

The required acid concentration and immersion time shall be determined by test prior to the pickling operation (see E–26.3).

b. Rinse thoroughly in cold running water, air dry, or dry in air oven at 180_ to 240_F (82_ to 116_C).

c. Apply final protective finish, if required (see E–39).

E–38. CORROSION REMOVAL – COMPOUND MIL–C–38334 METHOD. Corrosion removal, compound prepaint for aluminum surfaces, Specification MIL–C–38334, may also be used on titanium to remove corrosion products. The corrosion removal compound should be applied to the titanium in the same manner as it is to aluminum (see E–14.2.1).

E–39. TYPICAL PAINT SYSTEMS. Titanium does not normally require a paint system for corrosion protection. Where organic finishes are required for decorative purposes or for contact with a dissimilar anodic material, prepare titanium surface for painting by applying thixotropic MIL–C–81706 solution prepared in accordance with 5–9.1.1(c). Refer to T.O. 1–1–4 and –23 T.O.'s for aircraft, T.O. 35–1–3 for support equipment, or specific repair T.O.'s in order to determine the proper paint system to be used. See T.O. 1–1–8 for application procedures.

Table E-12. Typical Corrosion Removal of Titanium and Titanium Base Alloys

Type of Corrosion	Corrosion Removal	Protective Finish
Light or heavy oxide on parts where acid pickling is practical	(1) Remove gray or black oxide by mechanical method (refer to Chapter 5) (2) Remove remaining oxide by immersion in nitric-hydrofluoric acid solution (see E-37)	When required, see E-39

SECTION IX

CHEMICAL CORROSION REMOVAL, PLATED AND PHOSPHATED SURFACES

WARNING

Many platings and their corrosion products, such as copper, cadmium, and chromium are toxic. Take proper safety precautions to avoid inhalation or ingestion during corrosion removal. Wash hands thoroughly before eating or smoking after removing corrosion from plated surfaces.

E–40. INTRODUCTION. This section outlines procedures for the chemical corrosion removal from plated and phosphated surfaces. The intent of Table E–13 is to provide guidelines for the touchup of corroded areas; however, where an organic finish on the plated part is not objectionable for engineering or other reasons, the table can be used as a guide for treating the entire surface of the plated or phosphated parts.

E–41. PREPARATION. If the corroded area is soiled by grease, dirt, or other foreign materials, or requires paint removal, consult Chapter 3. Chemical corrosion removal is recommended for use where there is no danger of the chemicals becoming entrapped in crevices or recesses. Acid type chemical rust removers are recommended. They are intended for removing red rust and other types of corrosion from the base metal by brush application of the chemical following removal of heavy corrosion by mechanical means, and for conditioning the metal surface to improve paint adhesion. Protect adjacent components from scale, corrosion products, and chemical agents. Clean the area with MIL–C–87937 cleaner or solvent to remove grease or other soil (see Chapter 3).

E–42. TOUCH–UP OF CORRODED AREAS ON CADMIUM OR ZINC PLATED SURFACES. Cadmium and zinc plate provide anodic protection to underlying base metal. If, during normal use, the plated surface is broken, the cadmium or zinc plate will be anodic to the base metal (usually steel or copper alloy); therefore, the plate will corrode and sacrificially protect the base metal. The removal of corrosion from cadmium or zinc plated surfaces shall be limited to the removal of the corrosion products from the underlying base metal. Mechanical corrosion removal methods shall be used. The procedures are as follows:

a. Remove corrosion products from the base metal with abrasive paper or abrasive nylon pad. Avoid removing undamaged cadmium or zinc plate adjacent to the corroded area. Corrosion removal shall be limited to the immediate area of the corrosion on the base metal (see Chapter 5).

b. Remove any remaining corrosion and condition of the metal surface with phosphoric acid–base rust remover (MIL–C–10578). Allow the acid to contact the surface only long enough to remove the corrosion, and then rinse the area thoroughly with clean water.

c. Allow the area to dry, and immediately apply final protective paint or other corrosion preventive finish (see E–45).

NOTE

The above procedures are intended only for touch–up of corroded areas on cadmium or zinc plated surfaces. Where service temperatures preclude the use of organic finishes or the thickness of the organic finish will impair the operation of the part, severely corroded parts must be replaced. Where facilities are available, severely corroded cadmium plated parts may be replaced in accordance with the requirements of T.O. 42C2–1–7. Use only those plating procedures authorized when high strength steels are being replated, as many plating solutions can cause hydrogen embrittlement of these materials.

Table E–13. Typical Corrosion Removal Procedures for Plated and Phosphated Surfaces

Type of Corrosion	Corrosion Removal	Final protective Finish
Light corrosion of base metal under cadmium or zinc plate	Remove corrosion from base metal with an abrasive nylon pad (see E–42). Complete corrosion removal and condition metal with phosphoric acid–base rust remover (MIL–C–10578) (see E–22.1).	See E–45 for discussion of typical paint systems.
Light corrosion of base metal under tin, chromium, nickel, or copper plate	Remove corrosion from base metal, using mechanical methods (see E–43), followed by metal conditioning with phosphoric acid–base rust remover (MIL–C–10578) (see E–22.1).	As above
Heavy corrosion of base metal under cadmium, zinc, chromium, nickel, or copper plate	As above	As above

*The final protective finish should only be applied where the service temperature of the pan does not preclude the use of an organic finish or where the thickness of the finish will not impair the operation of the part.

E–43. TOUCH–UP OF CORRODED AREAS ON PLATED PARTS (EXCEPT THOSE PLATED WITH CADMIUM OR ZINC). When a break occurs in the surface of plates, such as chromium, nickel, tin, or copper, corrosion of the base will rapidly follow. The corrosion will normally be accelerated because the above plates are cathodic to most base metals.

a. Protect adjacent components from scale, corrosion products, and chemical agents.

b. Clean the area with MIL–C–87937, or MIL–PRF–85570 cleaner or solvent material to remove grease or other soil (see Chapter 3).

c. Remove heavy corrosion by mechanical means, such as wire brushing or abrasion with abrasive paper or nylon pad (see Chapter 5).

d. Remove any remaining corrosion and condition the metal surface with phosphoric acid–base rust remover (MIL–C–10578). Allow the acid to contact the surface only long enough to remove the corrosion.

e. Thoroughly rinse the acid from the surface with clean water.

f. Allow the area to dry and immediately apply final protective paint or other corrosion preventive finish.

NOTE

The above procedures are limited to touch–up of corroded areas on chromium, nickel, tin, and copper plate. Where service temperatures preclude the use of organic finishes or the thickness of the organic finish will impair normal operation of the part, severely corroded parts must be replaced. Where facilities are available, severely corroded plated parts may be replated in accordance with the requirements of T.O. 42C2–1–7. Use only those plating procedures authorized when high strength steels are being replated, as many plating solutions can cause hydrogen embrittlement of these materials.

E–44. CORROSION REMOVAL AND TREATMENT OF PHOSPHATED SURFACES. The surfaces of cadmium, zinc, and steel are frequently treated with a phosphate coating at the time of manufacture to improve paint adhesion and corrosion resistance of the surfaces or to provide a base for the application of grease, oil, or CPC's. When phosphated surfaces corrode, corrosion should be removed by the method recommended for the base material.

E–45. TYPICAL PAINT SYSTEMS. Paint may be used to prevent further corrosion on plated or phosphated surfaces, provided that the part does not operate at temperatures which preclude the use of organic finishes or where the finish will not prevent the part from performing its intended function. Organic finishes shall not be used on bearing or wearing surfaces of gears, cams, slides, etc., where an electrical conducting surface is required, where the finish will prevent the part from performing its intended function. Finishes consistent with the requirements for corrosion protection of the base metal should be used. Refer to T.O. 1–1–4 and –23 T.O.'s for aircraft, T.O. 35–1–3 for support equipment, or specific repair T.O.'s in order to determine the proper paint system to be used. See T.O. 1–1–8 for application procedures.

SECTION X

CORROSION CONTROL EQUIPMENT AND MATERIALS

Table E–14. Corrosion Control Equipment

Item	National Stock Number	Intended Use
Abrasive Mask	4240–00–270–4416	Personnel protection during sand or abrasive blasting
Air Regulator	4240–01–029–7148	Regulating air to the abrasive mask
(Replacement filters)	4240–01–029–7154	
Apron – General Purpose, Rubber Coated	8415–00–082–6108	Personnel protection during chemical corrosion removal
Barrel Mounted Pump (Air Driven) 432 BRS	4940–00–780–3202	For application of chemicals to aircraft, etc.
Blast Cleaning Machine MIL–C–83756, Type II (vacuum blaster)	4940–00–780–5500	Corrosion removal from aircraft parts
Blasting Room, 20 ft long by 10 ft wide by 10 ft high	4940–00–099–9208	Sand or abrasive blasting of support equipment and aircraft parts
Boot, Hip, size 10	8430–00–241–2780	Personnel protection
Boot, Knee, size 10	8430–00–147–1035	Personnel protection
Compressor, Low Pressure, Diaphragm	4310–00–684–4313	Use with abrasive mask
Deburring Tool Pneu	5130–00–430–4829	For corrosion removal mechanical
Degreaser, Stationary 48 in by 36 in by 30 in, 20 gal	4940–00–141–8504	Degreasing parts
Funnel, Stainless	7240–00–933–8007	To facilitate pouring
Gloves, Rubber, size 10	8415–00–266–8677	Personnel protection
Grinder Pneu, Geared, Governed	5130–00–401–9861	For corrosion removal mechanical
Grinder – Portable, Flex Shaft	5130–00–765–5212	For corrosion removal mechanical

Table E–14. Corrosion Control Equipment (Cont.)

Item	National Stock Number	Intended Use
Holder, Almen Strip	5120–01–044–4554	Roto–Peen process
Hood, Abrasive Cleaning	4240–00–278–9961	Personnel protection; use with abrasive mask
Hose, Air General Purpose 3/4 in ID by 50 ft	4720–00–851–0906	Use for abrasive blasting
Indicator (depth)	5520–00–601–3043	Determining depth of corrosion pits
Kit, Metal Identification	6630–00–831–5932	To identify metals and surface treatments
Mandrel P/N TC 330–7210	5130–01–071–7449	For the 1–1/4 x 9/16” Roto–Peen Flap
Mandrel P/N TC 330–7211	5130–01–044–4549	For the 1 x 2” Roto–Peen Flap
Mandrel P/N TC 330–7212	5130–01–069–3228	For the 1 x 9/16” Roto–Peen Flap
Pail, Rubber, 3 gal	7240–01–150–0716	For use with chemical solutions
Platform, connecting, Type A–1, 4 x 14 ft	1730–00–491–0607	Corrosion control work on aircraft
Platform, Maintenance Adj 3–7 ft, Type B–4A	1730–00–294–8883	Corrosion control work on aircraft
Platform, Maintenance Adj 7–12 ft, Type B–5A	1730–00–294–8884	Washing and corrosion control work on aircraft
Platform, Maintenance Adj 23–43 ft, Type B–3	1730–00–294–9129	Washing and corrosion control work on aircraft
Platform, Maintenance Adj 13–20 ft, Type B–2, P/N 48J20090	1730–00–390–5620	Washing and corrosion control work on aircraft
Platform–Maintenance Fixed 4 ft, Type C–1	1730–00–395–2781	Washing and corrosion control work on aircraft
Refrigerator, Expl Proof	4110–01–008–1011	Storage of sealants
Sander, Disk, Pneu, Portable	5130–00–204–0623	Corrosion removal mechanical; scuffing paint prior to touchup

Table E– 14. Corrosion Control Equipment (Cont.)

Item	National Stock Number	Intended Use
Sprayer, Insecticide (manually carried and operated, 8 qt cap)	3740–00–641–4719	For application of corrosion preventive compounds
Test Paper and Color Chart, Hydrogen Ion (pH)	6630–00–442–9005	Testing and pH of alodine and other solutions
Vacuum Cleaner, Explosion Proof, W–C–421, Type I, Class B, Size 2	7910–00–526–1959	Heavy duty cleaning
Vacuum Cleaner, W–C–421, Type I, Class D (household type)	7910–00–550–9123	Light duty cleaning
Vacuum Blast, Pump Kit	4940–00–948–3810	Required for use with Vacuum Blaster NSN 4940–00–780–5500 when 90 cfm air is not available

Table E-15. Corrosion Control Materials

NOTE

Items previously listed in T.O. 1-1-1 which do not appear in this table are located in Appendix A or B.

Item	Specification	National Stock Number	Unit of Issue	Intended Use
Abrasive Wheel, Flat, Aluminum Oxide, 6 in D, 1/2 in Arbor (fine)	MIL-W-81319 Class 2, Type I Grade B	5345-00-732-9977	EA	Removal of corrosion by grinding
Abrasive Wheel, Flat, Aluminum Oxide, 6 in D, 1/2 in Arbor (med)	MIL-W-81319 Class 2, Type I Grade C	5345-00-732-9988	EA	Removal of corrosion by grinding
Abrasive Wheel, Flat, Laminated Aluminum Oxide, 6 in D, 1 in Arbor (med)	MIL-W-81319 Class 1, Type I	5345-00-762-3166	EA	Removal of corrosion by grinding
Abrasive Wheel, Flat, Laminated, 6 in D, 1 in Arbor (fine)	MIL-W-81319 Class 1, Type I Grade B	5345-00-762-3175	EA	Removal of corrosion by grinding
Almen Test Strip	MIL-S-13165	1680-01-073-3353	EA	Peening effect measurement
Aluminum Oxide	MIL-A-21380 Type 1, Grade A	5350-00-619-8973	100 lb	Removal of steel corrosion by blasting
Aluminum Oxide Cloth No. 400	A-A-1048 Type 1	5350-00-865-5700		Removal of corrosion from aluminum
Brush Calcimine, 7/8 in x 5-1/8 in	H-B-141, Type F	8020-00-242-2573		To apply paint and hydrochloric acid
Brush, Cleaning, Aircraft, Type 1, Style 1	A-A-3080	7920-00-054-7768	EA	Applying corrosion removing, cleaning, and paint removing compounds
Brush, Wire, Rotary, Stainless Steel	H-B-771, Type III Class 1, Style A, 4 in diam 1-1/2 in diam 1 in diam	5130-00-880-3547 5130-00-880-3546 5130-00-880-3545	EA	To remove corrosion products

Table–15. Corrosion Control Materials (Cont.)

Item	Specification	National Stock Number	Unit of Issue	Intended Use
Brush, Wire Scratch, Corrosion Resistant Steel	H–B–178/3–2	7920–00–269–1259	EA	To remove corrosion products
Calcium Sulfate		6810–00–242–4066	1 lb	Used in AMS–M–3171 treatment solutions
Can, Flammable, Waste, 6 gal	RR–C–14, Type I	7240–00–282–8411	EA	For temporary storage and disposal of flammable waste
Can, Safety, Steel		7240–00–178–8285	EA	To hold solvents
Chromate Conversion Coating	MIL–C–81706 Class 1A Form II powder	8030–00–811–3723 8030–00–926–9131	24 lb 5 lb	Surface treatment 5 lb of aluminum
Chromium Trioxide (Chromic Acid)	O–C–303	6810–00–264–6517	5 lb	Use in MIL–M–3171 treatment solutions
Cleaning Compound Aerospace equipment	MIL–C–87937 Type I	6850–01–390–7808 6850–01–390–7811 6850–01–390–7816 6850–01–390–7821	1 Gal 5 Gal 55 Gal Bulk (Greater than 55 Gal)	Cleaning aircraft surfaces
	Type II	6850–01–390–7827 6850–01–399–5227 6850–01–399–5228	1 Gal 5 Gal 55 Gal	
	Type III	6850–01–390–9453	55 Gal	
Corrosion Preventive	MIL–C–6529 Type I	6850–00–281–2031	5 gal	Engine and equipment anti–corrosion compound
Corrosion Preventive Compound, Petrolatum Hot Application	MIL–C–11796 Class 3	8030–00–231–2353	5 lb	Soft film corrosion preventive compound

Table-15. Corrosion Control Materials (Cont.)

Item	Specification	National Stock Number	Unit of Issue	Intended Use
Corrosion Preventive Compound, Solvent Cutback, Cold Application	MIL-PRF-16173 Grade 1	8030-00-062-6950 8030-00-231-2345 8030-00-244-1299	1 qt 1 gal 5 gal	Preservative material hard film for long term protection of metallic surfaces and control cables
	Grade 3	8030-00-837-6557	12/48 pt	A very light water displacing compound
Corrosion Removal Compound, Prepaint	MIL-C-38334	6850-00-527-2426	5 gal	For aluminum corrosion removal prior to painting
Corrosion Removing Compound, Paste	MIL-C-10578	6850-00-543-7829	1 qt	For removal of corrosion from vertical overhead surfaces
Corrosion Removing Compound, Alkaline	MIL-C-14460 Type I	6850-00-935-5853	400 lb	Removal of rust and scale from ferrous surfaces
Corrosion Remover, "Pasa-Jell 101"		6850-00-227-8201	1 qt	Cleaning and passivating stainless steel in contact with LOX
Corrosion Remover, "Pasa-Jell 102"		6850-01-228-0074	1 qt	Cleaning aluminum in contact with LOX
Goggles, Safety	A-A-1110 Class 1	4240-00-052-3776	EA	Personnel protection
Grain Abrasive	MIL-G-5634 Type III	5350-00-050-1094	50 lb	Removal of corrosion from stainless steel by blasting
Grease	MIL-G-23549	9150-00-985-7316	1 lb	General purpose grease
Hydrofluoric Acid	MIL-A-24641	6810-00-543-4012	1 gal	Used in pickling solutions
Kit Disc, Abrasive		5180-01-015-1419	EA	Removal of corrosion by grinding
Lubrication Oil, Jet Engine	Grade 1010 per MIL-L-6081	9150-00-273-6671 9150-00-273-8807 9150-00-231-6671	1 qt. 1 gal 55 gal	
Metal Conditioner and Rust Remover	MIL-C-10578 Type III	6850-00-201-1218	1 gal	Rust removal from ferrous metals; etching to promote adhesion of coating

Table E–15. Corrosion Control Materials (Cont.)

Item	Specification	National Stock Number	Unit of Issue	Intended Use
Nitric Acid	O–N–350	6810–00–222–9655	1 pt	pH adjustment of chemical conversion treatment solutions for aluminum
Potassium fluoride		6810–00–023–9682	1 lb	Component of mixture for removing light corrosion from aluminum in dip tanks
Rags	A–A–2522	7020–00–205–3571	50 lb	Used for general wiping purposes
Roto–Peen Flap (3M)	MIL–R–81841 Type II			Roto–Peening
	Class 1 (1 x 2”)	5130–00–553–0235	EA	
	Class 2 (1 1/2 x 9/16”)	5130–01–053–5165	EA	
	Class 3 (1 x 9/16”)	5130–01–044–4549	EA	
Sealing Compound, Environmental	MIL–S–38228	8030–00–782–1420 8030–00–782–7782	6 oz	Filling and sealing exterior aircraft and missile surfaces to effect smooth contour
Sodium Bisulfate	MIL–S–16917	6810–00–281–2044	100 lb	Component of mixture for removing light corrosion from aluminum in dip tanks
Sodium Dichromate	O–S–595	6810–00–262–8566	5 lb	Used in chemical corrosion removal solutions
Soil Barrier Coating “Cee Bee A–6”		8030–01–271–4099	5 gal	Protection of painted surfaces from gun blast residue or engine exhaust deposits
Soil Barrier Coating Remover “Cee Bee A–276”		6850–01–162–2424 6850–01–162–2693	55 gal 5 gal	Removal of soil barrier coating
Sponge, Synthetic	A–A–2073	7920–00–633–9915	EA	For washing, wiping and applying solutions

Table E–15. Corrosion Control Materials (Cont.)

Item	Specification	National Stock Number	Unit of Issue	Intended Use
Steel, Grit	MIL–S–851 Size 25 Size 50 Size 120 Size 230	 5350–00–271–5986 5350–00–271–5988 5350–00–230–3224 5350–00–426–0648	 100 lb 100 lb 100 lb 100 lb	Removal of corrosion and paint from ferrous surfaces except stainless steel
Sulfuric Acid	O–S–809	6810–00–227–1845	5 pt	Used in chemical corrosion removal solutions
Tape, 3M Aluminum foil tape	Tape No. 425	Open purchase		Masking for extensive operations
Tribasic Sodium Phosphate	O–S–642	6810–00–141–6078 6810–00–140–6080	1 lb 100 lb	Removal of fungus from wood

GLOSSARY

Active metal. A metal ready to corrode, or being corroded.

Additive. A compound added for a particular purpose; for example, additives in fuel and lubricants can prevent corrosion, gum formation, varnishing, sludge formation, and knocking.

Aeration cell. An electrolytic cell in which the driving force to cause corrosion results from a difference in the amount of oxygen in solution at one point as compared to another. Corrosion is accelerated in areas where the oxygen concentration is least, for example, in a stuffing box or under packing.

Aircraft Controlling Custodian. Navy command responsible for specific aircraft (AIRLANT, AIRPAC, CNAVRES, CNATRA, or NAVAIR).

Alloy. A combination of two or more metals.

Alkaline. Having a pH of more than 7.

Anaerobic. A process which is capable of occurring in the absence of oxygen.

Anion. A negatively charged ion of an electrolyte which migrates toward the anode. The chloride ion in sea water is an anion.

Anode. The electrode of a corrosion cell at which oxidation or corrosion occurs. It may be a small area on the surface of a metal or alloy, such as that where a pit develops, or it may be the more active metal in a cell composed of two dissimilar metal, (i.e., the one with the greater tendency to go into solution). The corrosion process involves the change of metal atoms into cations with a liberation of electrons that migrate through the metal to the cathode of the cell.

Anodic protection. The reduction or elimination of corrosion of a metal than can sometime be achieved by making current flow from it to the solution by connecting it to the positive pole of a source of current. Under most conditions, as the potential of an initially active metal is gradually shifted in a more noble direction, such as by potentiostatic means, the corrosion current gradually increases. However, with suitable combinations of metal and solution, a critical potential is soon reached. At somewhat higher values of potential, the current drops to a very low value, and the metal becomes passive. The potential of metal has to be regulated by a potentiostat.

Anodize. To subject (a metal) to electrolytic action as the anode of a cell in order to coat with a protective or decorative film (anodic oxidation film).

Austenitic. A term applied to that condition of iron associated with a change in crystal structure that makes it non–magnetic. This occurs with ordinary iron at an elevated temperature. When sufficient chromium and nickel are present, lead becomes austenitic (non–magnetic) at atmosphere temperatures. This is the case with the many stainless metals that combine about 18% chromium and 8% or more nickel.

Cathode. The less active electrode of a corrosion cell, where the action of the corrosion current causes reduction and the nearly complete elimination of corrosion.

Cathodic Protection. The reduction or elimination of corrosion of a metal that is achieved by making current flow to it from a solution, such as connecting it to the negative pole of some source current. The source of the protective current may be sacrificial metal, such as magnesium, zinc, or aluminum. The current may also be derived from a rectifier, generator, or battery applied through an appropriate anode which may be connected by the applied current (as in the case of steel), or which remains substantially unaffected by the current, as in the case of platinum. Cathodic protection may become complete when anodic reactions are completely suppressed and only cathodic reactions occur on the metal surface.

Cation. A positively charged ion of an electrolyte which migrates toward the cathode. Metallic ions, such as iron or copper, are cations.

Caustic embrittlement. The result of the combined action of tensile stress and corrosion is an alkaline solution that causes embrittlement. This is most frequently encountered in the laps of riveted boilers where the required concentration of the alkali in the boiler water occurs.

Cavitation. The formation of treatment voids or vacuum bubbles in a liquid stream passing over some surface. This is often encountered around propellers, rudders, struts, and in pumps.

Cell. In corrosion processes a cell is a source of electrical current that is responsible for corrosion. It consists of an anode and a cathode immersed in an electrolyte and electrically joined together. The anode and cathode may be separate metals or dissimilar area on the same metal.

Chalking. Deterioration of an organic coating upon exposure that results in a powdery, chalky residue on the painted surface.

Chemical conversion coating. A film that is deliberately produced on a metal by immersing it in, brushing it with, or spraying it with a selected chemical solution for the purpose of providing improved corrosion resistance to the metal or increasing the adhesion of organic coatings to be applied later. Coatings covered by MIL–C–5541 are examples.

Clear water. Colorless water containing no visible suspended particles.

Combustible liquid. Any liquid having a flashpoint at or above 100_F, but below 200_F.

Concentration cell. An electrolytic cell consisting of an electrolyte and two electrodes of the same metal or alloy that develops a difference in potential as a result of a difference in concentration of ions (most often metal ions) or oxygen at different points in a solution.

Corrosion fatigue. A reduction in the ability of a metal to withstand cyclic stress caused by its exposure to a corrosive environment.

Corrosion rate. The speed of corrosion attack. It is usually expressed in terms of weight loss per unit of time.

Couple. Two or more metals or alloys in electrical contact with each other so that they can act as the electrodes of a cell if they are immersed in an electrolyte.

Cracking.

a. Localized breaking of a paint film to expose the underlying material.

b. Breaking of a metal or alloy in a brittle fashion along a narrow path or network.

Crevice corrosion. Corrosion occurring within a crevice formed by two or more parts of the same or different metals or formed by a metal and non–metallic material. Stainless steel and aluminum alloys are particularly susceptible to crevice corrosion.

Critical humidity. The relative humidity, under a specific set of conditions, at which a metal or an alloy will begin to corrode. In the presence of hygroscopic (moisture absorptive) solids or corrosion products, the critical humidity will be lowered. Steel will not corrode if the relative humidity is less than 30% in a marine atmosphere.

Deposit attack. When foreign material (dirt, corrosion products) is deposited on the surface of a metal, it may shield the metal from the oxygen necessary to regenerate a protective oxide layer. An oxygen concentration cell is formed, and serious corrosion may result.

Electrochemical Corrosion.Corrosion which occurs when current flows between cathodic and anodic areas on metallic surfaces.

Electrode. A metal or alloy that is in contact with electrolyte and serves as the site where electricity passes in either direction between the electrolyte and metal. The current in the electrode itself is a flow of electrons, whereas, in the electrolyte, ions carry electric charges and their orderly movement in solution constitutes a flow of current in the electrolyte.

Electrolysis. In the strict sense of the term, electrolysis concerns chemical changes in the solution or electrolyte due to the passage of current. Its relation to corrosion arises only if the corrosion process alters the make–up of the solution. Hence, since the term is most closely related to solution phenomena then to corrosion, its use to indicate corrosion should be discouraged.

Electrolyte. Any substance which, in solution or fused, exists as electrically charged ions that render the liquid capable of conducting a current. Soluble acids, bases, and salts, such as sea water, are electrolytes.

Electromagnetic Interference (EMI). Radiation generated from electromagnetic fields which are produced by radar antennas, Radio Frequency (RF) antennas, shipboard transmitters, certain poorly designed avionics units, electric motors, and lightning and other natural effects. This type of radiation can interfere with aircraft avionics systems causing electrical malfunctions.

Electromotive force (EMF) series. A list of elements according to their standard electrode potentials. The more negative the potential the greater the tendency of the metal to corrode. This series is useful in studies of thermodynamic properties, but does not indicate the rates of corrosion. A hydrogen gas electrode is the standard reference and its potential is designated as zero. All potentials are positive or negative with respect to the hydrogen electrode. In this country the potentials of zinc and iron are designated as negative and those of copper and platinum as positive.

Embrittlement. Severe loss of ductility of a metal alloy that results in a brittle fashion.

Erosion. Destruction of a metal by the combined action of corrosion and abrasion or attrition by a liquid or gas with or without suspended matter.

Exfoliation. The breaking away of a material from its surface in flakes or layers.

Faying surface. The common surface between mating parts.

Feathering. To spread out (as paint) especially around the edges of a particular area in order to blend in with adjoining matter and leave no clear lines of distinction.

Filiform corrosion. Corrosion that develops under coatings on metals as fine ragged hairlines, usually wavy or curved and randomly distributed.

Film. A thin layer of material that may or may not be visible.

Flammable liquid. Any liquid have a flash point of 100_F or less.

Flashpoint. The minimum temperature at which a liquid gives off an ignitable vapor in any one of the closed cup flashpoint testers (Pensky–Martens, Tagliabue, or Setaflash).

Fretting corrosion. Corrosion at the interface of two connecting surfaces, usually under high pressure and subject to very minute slippage due to relative vibration of surfaces that ordinarily are not supposed to move relative to each other, as a shrink fit.

Galvanic. The flow of direct current between dissimilar metals.

Galvanic corrosion. The accelerated corrosion of a metal that is associated with the flow of a less active metal in the same solution and in contact with the more active metal.

Galvanic series. A list of metals and alloys arranged in order of their relative potentials in a given environment. The order of their arrangement in this list may be different in other environments.

Hazardous material. A material which may pose a threat to human health or the environment when improperly handled or disposed of.

Hazardous waste. Waste which is characterized by the Environmental Protection Agency (EPA) as 1) ignitable, 2) corrosive, 3) reaction, or 4) toxic, as defined in 40 CFR 261, or is a listed hazardous waste identified in that regulation.

Hydrogen embrittlement. Loss of ductility of a metal, caused by the entrance or absorption of hydrogen ions into the metals, as in the pickling of metal.

Impingement attack. Corrosion that is associated with turbulent flow of a liquid, as at the entrance of a condenser tube or around bends in a pipe line.

Inhibitor. As applied to corrosion, a chemical substance or mixture which, when added in small amounts to a solution, markedly decreases corrosion.

Inorganic coatings. Electroplated coatings, conversion coatings, anodic coatings, phosphate coatings, and oxide coatings.

Ion. An electrically charged atom or group of atoms. The sign of the charge is positive in the case of cations and negative in the case of anions.

Local cell. A cell in which the driving force is due to a difference in potential between areas on a metal or alloy surface immersed in an electrolyte. The potential difference may be due to inclusions. Lack of homogeneity, varying concentration of the solution with respect to oxygen or metal ions. etc.

Matte surface. A surface with a low specular reflectivity, as in the case of an etched or sand–blasted surface.

Metal ion concentration cell. A cell established on a metal surface due to different concentrations of its ions in the electrolyte which is in contact with the metal surface. These variations in concentration result in local differences in potential, thus allowing the establishment of a local cell.

Mill scale. The heavy oxide layer formed during hot fabrication or heat treatment of metals. The term is most frequently applied to the scale of mixed iron oxides on iron and steel.

Mottling. Appearance of spotting or blotches of different color or shades of coloring.

Noble metal. A metal usually found as uncombined metal in nature. Platinum, gold, and silver are noble metals.

Non–destructive Inspection. A method used to check the soundness of a material or a part without impairing or destroying the serviceability of the part.

Organic coatings. Paint, lacquer, plastics, greases, etc.

Oxidation. Any change involving the loss of electrons by an atom. Any corrosion process involves oxidation of the metal in a true chemical sense. It also may imply the destruction of a metal or alloy as a result of the direct action of oxygen on the metal, e.g., the scaling of steel at high temperatures.

Ozone. A triatomic (O_3) form of oxygen and is formed naturally in the upper atmosphere by a photochemical reaction with solar ultraviolet radiation. The generation of the ozone layer in the upper atmosphere helps to minimize/reduce the amount of harmful ultraviolet radiation produced by the sun. Destruction of the ozone layer has been attributed to a variety of processes such as (1) thermal destruction, (2) photochemical reactions, (3) reaction with airborne particles, (4) reaction with the surface of the earth, and (5) reaction with airborne gases.

Room Temperature Vulcanizing (RTV). A process for treating or curing of synthetic rubber or plastic materials which occurs at room temperature.

Ultraviolet (UV) light. Light (electromagnetic radiation) of a wavelength shorter than visible light but longer than X–ray radiation. Long wavelength UV from the sun causes sunburn. Short wavelength UV from unfiltered UV lamps can damage unprotected eyes.

Uniform surface corrosion. Corrosive etching of metal involving only the surface.

Wording. The following definitions are adhered to in preparing this manual.

Shall is used only when a procedure is mandatory.

Should is used only when a procedure is recommended but not mandatory.

Solvent. A liquid substance capable of dissolving or dispersing one or more other substances.

Thixotropic. Gel–like in physical property.

Titration. A method or the process of determining the concentration of a dissolved substance in terms of the smallest amount of a reagent of known concentration required to bring about a given effect in reaction with a known volume of the test solution.

May is used only when a procedure is optional.

Will indicates future action but never to indicate a mandatory procedure.

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